ELECTRICAL WORLD

MAY 7, 1938

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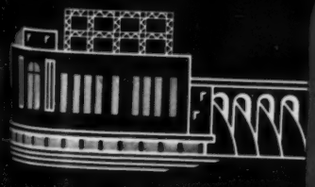
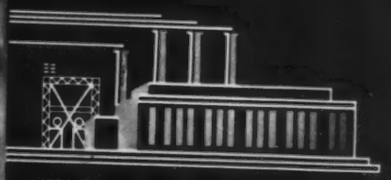


With this issue as a supplement

26th ANNUAL SURVEY

ONE HUNDRED MILLION KW.-HR. SYSTEMS



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Supplement to ELECTRICAL WORLD, May 7, 1938
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Table I—Data on Output and Peak Load of Largest Generating and Dist in North America, 1931—1937

Public utility, lighting, power and electric railway systems in the United States, Canada and Mexico having output in excess of 100,000,000 kw.-hr. during 1937

Line No.	Company or System	1937			1936			1935			1934		1933			1932	
		System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a)	Peak Load on Generator Stations (30-Minute) Kw. (See Note
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	United States																
1	Niagara Hudson Power Corporation (*C*)	(o) 1,274,300	(o) 1,091,400	8,056,607	(o) 1,232,700	(o) 1,122,900	7,558,595	(o) 1,155,400	(o) 1,019,600	7,063,368	(o) 1,098,900	6,393,719	1,046,700	(o) 823,300	5,968,614	(o) 923,368	(o) 796,
2	Commonwealth Edison Group *	1,402,700	1,391,100	7,124,493	1,348,600	1,342,400	6,502,175	Earlier	figures not com	parable							
3	Consolidated Edison Co. of New York, Inc. & Asso. Elec. Cos. (*H*)	1,507,500	1,459,000	6,538,147	1,449,000	1,446,000	6,038,990	1,307,000	1,231,000	5,493,400	1,224,000	5,278,800	1,176,000	1,104,000	5,015,100	1,189,400	1,189,
4	Pacific Gas and Electric Co. (Consolidated System)	990,200	.....	5,182,043	929,700	.....	4,911,965	857,900	.....	4,463,310	827,800	4,418,302	754,800	.....	4,048,124	728,900	.....
5	American Gas and Electric Co. (Interconnected System)	(o) 822,460	(o) 794,600	4,780,963	(o) 800,120	(o) 769,945	4,430,935	(o) 733,000	(o) 733,000	3,819,332	(o) 628,000	3,401,516	.....	.....	.....	.....	.....
6	Philadelphia Electric Company System	789,000	834,000	3,833,949	(m) 831,000	(m) 837,000	3,606,749	745,000	746,000	3,210,339	675,000	3,098,746	.....	619,000	2,946,681	.....	626,
7	The Detroit Edison Company	660,100	653,000	3,217,075	671,000	656,200	2,933,174	557,200	554,000	2,534,561	481,800	2,204,958	.....	415,200	1,908,672	420,300	.....
8	Southern California Edison Company, Ltd	(m) 580,500	.....	3,138,654	(m) 645,400	.....	3,492,532	561,900	560,000	3,139,307	516,300	2,917,593	508,700	506,800	2,772,640	516,500	514,
9	Public Service Electric and Gas Company	575,650	519,000	2,747,123	582,225	502,750	2,531,677	526,600	510,000	2,269,425	489,700	2,135,937	488,900	463,250	2,038,096	456,100	373,
10	American Water Works and Electric Company, Inc	(o) 432,759	(o) 411,600	2,543,471	(o) 416,392	(o) 399,342	2,405,317	(o) 374,784	(o) 370,300	2,068,153	(o) 320,309	1,781,782	(o) 306,061	(o) 305,501	1,657,438	(o) 260,971	.....
11	Union Electric Company of Missouri and Subsidiaries	(m) 443,000	(m) 443,000	2,399,584	426,260	.....	2,199,210	(m) 389,548	.....	2,009,566	(m) 348,220	1,812,642	318,390	.....	1,696,605	329,506	.....
12	Duke Power Co.	(m) 494,745	.....	2,385,189	(m) 487,000	.....	2,176,846	(m) 440,000	(m) 354,000	1,792,111	(m) 410,000	1,641,749	403,100	300,000	1,765,737	405,400	334,
13	New England Power Association (Consolidated)	(o) 526,500	.....	2,373,707	(o) 529,400	.....	2,321,187	498,600	421,500	2,188,887	472,700	1,987,776	(o) 451,900	.....	2,011,436	(o) 467,300	.....
14	Alabama Power Company	(o) 505,900	(o) 496,900	2,347,861	491,900	410,500	2,261,068	(o) 408,120	(o) 406,200	1,942,586	(o) 391,340	1,719,798	(o) 390,720	.....	1,601,050	389,120	343,
15	Georgia Power Company	(o) 361,100	(o) 291,100	1,870,625	(o) 342,900	(o) 330,780	1,642,301	(o) 325,909	(o) 286,640	1,445,556	(o) 282,500	1,206,989	(o) 284,860	.....	1,252,193	(o) 275,660	(o) 268,
16	Pennsylvania Water & Power Co. and Safe Harbor W. P. Corp. (*f*)	(o) 335,500	(o) 335,500	1,848,643	(o) 334,000	(o) 334,000	1,320,075	(o) 328,500	(o) 328,500	1,429,694	(o) 293,900	1,216,669	(o) 256,800	(o) 256,800	1,314,265	(o) 222,100	(o) 222,
17	Duquesne Light Company	(o) 360,100	(o) 348,300	1,836,112	.....	367,000	1,644,712	(m) 295,000	(m) 295,000	1,403,253	(m) 270,000	1,331,858	264,000	264,000	1,211,956	245,000	245,
18	Pennsylvania Power & Light Company (*P*)	345,000	266,800	1,778,250	(o) 348,800	(o) 262,200	1,730,569	(o) 304,800	.....	1,522,749	(o) 310,000	1,482,349	(o) 280,100	(o) 198,940	1,402,223	(o) 281,600	(o) 229,
19	The Cleveland Electric Illuminating Company	(j) 360,223	(j) 362,223	1,707,031	353,868	354,868	1,641,551	333,782	333,782	1,457,969	307,828	1,341,906	309,392	.....	1,240,542	283,900	.....
20	Consumers Power Company	(o) 372,900	(o) 333,460	1,691,884	(o) 329,901	(o) 300,677	1,490,798	(o) 281,878	(o) 257,531	1,233,812	(o) 221,330	1,067,120	(o) 210,467	.....	928,828	237,343	197,
21	The Montana Power Company (*P*)	(o) 258,500	(o) 255,500	1,559,436	243,300	243,300	1,496,867	(o) 203,400	.....	1,292,318	(o) 169,500	1,011,018	159,600	159,600	889,321	119,700	119,
22	Columbia Gas & Electric Corp. and Subsidiary Companies	324,200	.....	1,510,463	308,000	.....	1,438,882	308,530	.....	1,252,490	257,860	1,121,784	261,000	.....	1,045,236	249,900	.....
23	Consolidated Gas, Electric Light & Power Co. of Baltimore	(r) 300,000	(o) 144,000 (g)	1,508,886	(r) 285,200	(o) 167,000 (g)	1,328,131	(r) 244,300	(o) 102,500 (g)	1,113,560	(r) 209,600 (g)	994,509	(r) 198,000	(o) 74,200 (g)	897,675	(o) 180,400	(o) 119,
24	The Milwaukee Electric Railway & Light and Affiliated Cos. (*p*)	343,061	.....	1,506,345	300,976	.....	1,366,641	(m) 262,718	.....	1,210,496	(m) 227,410	1,070,722	221,693	.....	974,871	231,969	.....
25	City of Los Angeles, Bureau of Power and Light	366,500	366,500	1,506,171	(m) 230,300	(m) 221,300	928,501	183,200	108,300	798,262	171,300	744,454	159,600	95,500	712,102	167,400	94,
26	Northern States Power Co. (Delaware) and Subsidiary Cos.	278,374	.....	1,319,245	.....	(z) 252,534	1,246,345	(m) 243,534	.....	1,098,472	225,448	1,029,300	.....	.....	963,928	204,461	.....
27	Ohio Edison Company	(o) 243,100	(o) 236,000	1,280,943	(o) 227,700	(o) 220,800	1,128,925	(o) 179,600	(o) 174,500	876,900	(o) 163,000	799,541	(o) 145,200	.....	715,770	(o) 153,000	(o) 134,
28	The Washington Water Power Company * (*o*) (*P*)	(o) 228,200	(o) 193,800 (v)	1,278,809	(o) 189,700	(o) 178,840	1,005,193	(o) 170,720	.....	854,380	(o) 143,420	762,886	118,785	118,785	634,984	128,135	128,
29	Boston Edison Company	(m) 305,430	(m) 249,040	1,274,633	(m) 320,966	(m) 278,000	1,266,045	(m) 321,842	(m) 251,000	1,224,563	(m) 288,545	1,112,072	283,595	219,000	1,073,311	265,563	213,
30	Puget Sound Power & Light Company	(m) 232,410	(m) 230,635 (q)	1,233,901	(m) 219,240	(m) 214,440	1,044,906	(m) 205,435	(m) 202,635	914,812	(m) 192,568	851,144	179,795	170,295	788,482	177,255	148,
31	Bureau of Reclamation (Boulder Dam)	319,200	319,200	1,166,681	162,000	162,000	120,884	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	Carolina Power & Light Company (*P*)	(o) 273,280	(o) 198,320	1,035,987	(o) 236,160	(o) 196,040	1,045,704	(o) 237,360	.....	1,059,547	(o) 239,720	1,103,009	(o) 234,250	(o) 170,920	966,328	(o) 208,600	(o) 178,
33	The Tennessee Electric Power Company	(o) 189,000	(o) 155,500	1,016,041	(o) 189,000	(o) 115,000	952,523	(o) 152,900	(o) 85,900	782,935	(o) 130,000	721,676	(o) 110,300	.....	575,047	145,740	106,
34	Metropolitan Edison Co. and New Jersey Power & Light Co.*	(o) 186,300	(o) 174,400	952,593	(o) 176,300	(o) 163,300	867,951	(o) 170,400	(o) 153,200	795,378	(o) 148,400	.....	(o) 147,900	(o) 138,300	713,138	(o) 143,860	(o) 125,
35	Utah Power & Light Company (*P*)	147,200	133,630	919,184	143,260	126,880	736,702	(o) 115,160	.....	564,307	(o) 95,510	518,737	90,710	66,340	476,412	103,710	67,
36	Potomac Electric Power Company and Small Affiliate	(o) 189,000	(o) 154,000	835,168	(t) 179,000	(u) 152,000	778,927	(m) 169,000	.....	725,464	(m) 164,000	662,833	148,000	.....	562,433	137,000	137,
37	New York State Electric & Gas Corp. and Affiliates * (*l*)	(o) 171,837	(o) 84,100	819,824	(o) 157,400	(o) 105,010	726,324	(o) 140,855	(o) 85,282	651,928	(o) 136,855	614,087	(o) 142,833	(o) 63,478	586,652	(o) 134,058	(o) 47,
38	Northern Indiana Public Service Company	137,610	82,300	811,820	123,210	82,470	603,143	88,016	.....	463,600	75,160	409,796	70,450	.....	403,796	72,600	70,
39	Public Service Company of Indiana	158,650	117,500	774,931	152,560	114,500	764,850	131,870	108,700	642,608	120,900	580,038	118,450	100,300	530,805	116,980	.....
40	Louisiana Power & Light Company (*P*)	.....	96,000	760,703	113,262	96,000	793,819	(o) 105,428	.....	572,219	(o) 106,377	583,409	110,188	97,000	530,645	112,988	103,
41	Kansas City Power & Light Company	151,700	151,700	757,407	135,100	135,100	721,326	(c) 132,400	(c) 129,900	652,655	(c) 126,200	626,909	.....	120,600	596,988	128,200	.....
42	The Connecticut Light and Power Company	154,872	129,935	748,186	(o) 149,504	(o) 124,443	700,104	(o) 137,053	.....	632,021	(o) 116,716	565,072	(o) 116,719	.....	557,825	(o) 114,425	.....
43	Portland General Electric Company	(o) 144,000	(o) 140,000	704,759	(o) 145,000	(o) 141,000	659,643	(o) 130,000	(o) 128,000	583,071	(o) 118,000	541,575	(o) 109,000	(o) 109,000	496,188	(o) 108,300	(o) 126,
44	Oklahoma Gas and Electric Company	125,096	124,104	691,821	.....	97,689	588,952	(m) 97,689	(m) 97,689	507,656	(m) 89,270	462,518	83,678	80,178	429,122	83,152	.....
45	Virginia Electric and Power Company	(o) 133,200	(o) 133,900	664,860	(o) 127,600	(o) 127,300	605,218	110,500	.....	531,015	102,900	520,750	102,400	92,000	506,713	104,200	97,
46	Houston Lighting & Power Company (*P*)	(o) 121,200	(o) 117,300	659,912	(o) 110,000	(o) 110,400	591,679	(o) 99,800	.....	517,942	(o) 90,000	482,255	83,000	80,900	442,468	(o) 82,600	(o) 79,
47	The Ohio Public Service Company	129,100	97,900	624,774	111,800	100,200	577,089	104,500	86,600	453,689	95,000	437,060	93,900	83,700	408,608	90,300	56,
48	Idaho Power Company (*P*)	(o) 92,302	(o) 86,085	609,466	(o) 81,797	(o) 78,667	517,962	(o) 69,680	.....	434,959	(o) 66,756	429,712	(o) 71,774	(o) 66,030	402,652	(o) 74,916	(o) 65,
49	Texas Power & Light Co. (*P*)	(o) 125,610	(o) 104,480	588,397	(o) 112,850	(o) 101,680	535,205	(o) 89,200	.....	448,880	(o) 91,000	444,191	(o) 101,630	(o) 82,240	482,671	(o) 102,540	(o) 82,
50	The California Oregon Power Company	110,980	106,175	575,585	.....	106,252	553,827	98,950	98,950	515,252	86,940	488,083	83,565	80,800	478,307	84,700	81,
51	The Toledo Edison Company	116,020	108,020	551,993	109,000	98,000	523,217	98,000	87,000	492,963	91,120	430,527	(o) 87,000	(o) 86,792	412,112	(o) 95,400	(o) 81,
52	Central Maine Power Company	101,900	100,200	536,254	(o) 104,660	.....	512,988	89,640	88,061	459,906	91,740	448,792	90,205	85,070	405,825	(o) 85,750	.....
53	Hetch Hetchy Water Supply, San Francisco	87,700	87,700	506,712	83,500	83,500	514,179	83,700	83,700	507,978	83,600	502,306	84,600	84,600	469,418	83,600	83,
54	Salt River Valley Water Users' Association	(o) 110,475	(o) 68,975	496,414	82,000	67,000	370,930	62,000	62,000	260,516	49,070	218,535	49,070	49,070	218,535	43,075	43,
55	Tennessee Valley Authority	(o) 160,400	(o) 160,400	494,799	213,500	213,500	770,639	180,000	180,000	386,600	133,000	200,352	121,000	121,300	287,862	128,000	136,
56	Western Mass. Companies and Its Constituent Cos	(o) 86,000	.....	494,773	91,000	.....	461,609	85,600	.....	460,014	78,100	430,668	74,800	.....	412,011	76,700	.....
57	South Carolina Elec. & Gas Corp. and Lexington W. P. Co.*	(o) 139,700	(o) 139,700	484,269	(o) 137,700	(o) 137,700	461,353	127,700	127,700	419,332	(o) 130,300	389,470	(o) 131,000	(o) 131,000	463,031	(o) 117,700	(o) 117,
58	Texas Electric Service (*P*)	(o) 83,988	(o) 83,369	477,809	(o) 88,422	(o) 87,900	401,644	(o) 75,383	.....	357,959	(o) 77,957	349,105	(o) 77,600	(o) 77,600	320,440	(o) 83,622	(o) 82,
59	Pennsylvania Electric Company and Affiliates *	91,150	90,070	475,274	(o) 88,560	(o) 88,160	440,969	(o) 83,472	(o) 83,370	400,303	(o) 79,560	381,226	(o) 72,980	(o) 70,080	358,792	(o) 74,820	(o) 73,
60	Indianapolis Power & Light Company	110,000	110,000	472,852	94,750	83,750	421,305	82,150	81,450	360,489	72,100	321,135			287,280		

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Output and Peak Load of Largest Generating and Distributing Systems in North America, 1931—1937

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1937			1936			1935			1934		1933			1932			1931			Line No.
System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (3)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (4)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (5)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (6)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (7)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (8)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (9)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (10)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (11)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (12)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (13)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (14)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (15)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (16)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (17)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (18)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (19)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (20)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (21)	Output for Year (Incl. Purch. Energy) Thous. Kw.-Hr. (22)	(23)
(o) 1,274,300	(o) 1,091,400	8,056,607	(o) 1,232,700	(o) 1,122,900	7,558,595	(o) 1,155,400	(o) 1,019,600	7,063,368	(o) 1,098,900	6,393,719	1,046,700	(o) 823,300	5,968,614	(o) 923,368	(o) 796,400	5,378,434	998,876	850,218	5,911,409	1
1,402,700	1,391,100	7,124,493	1,348,600	1,342,400	6,502,175	Earlier	figures not com	parable	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
1,507,500	1,459,000	6,538,147	1,449,000	1,446,000	6,038,990	1,307,000	1,231,000	5,493,400	1,224,000	5,278,800	1,176,000	1,104,000	5,015,100	1,189,400	1,189,400	4,981,200	1,240,000	1,240,000	5,138,200	3
990,200	.....	5,182,043	929,700	.....	4,911,965	857,900	.....	4,463,310	827,800	4,418,302	754,800	.....	4,048,124	728,900	.....	4,004,246	855,500	.....	4,558,552	4
(o) 822,460	(o) 794,600	4,780,963	(o) 800,120	(o) 769,945	4,430,935	(o) 733,000	(o) 733,000	3,819,332	(o) 628,000	3,401,516	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
789,000	834,000	3,833,949	(m) 831,000	(m) 837,000	3,606,749	745,000	746,000	3,210,339	675,000	3,098,746	.....	619,000	2,946,681	.....	626,000	2,860,722	.....	668,000	3,032,324	6
660,100	653,000	3,217,075	671,000	656,200	2,933,174	557,200	554,000	2,534,561	481,800	2,204,958	.....	415,200	1,908,672	420,300	.....	1,851,224	477,700	.....	2,170,255	7
(m) 580,500	.....	3,138,654	(m) 645,400	.....	3,492,532	561,900	560,000	3,139,307	516,300	2,917,593	508,700	506,800	2,772,640	516,500	514,400	2,856,603	558,200	554,900	3,061,837	8
575,650	519,000	2,747,123	582,225	502,750	2,531,677	526,600	510,000	2,269,425	489,700	2,135,937	488,900	463,250	2,038,096	456,100	373,850	2,037,605	462,700	366,500	2,170,513	9
(o) 432,759	(o) 411,600	2,543,471	(o) 416,392	(o) 399,342	2,405,317	(o) 374,784	(o) 370,300	2,068,153	(o) 320,309	1,781,782	(o) 306,061	(o) 305,501	1,657,438	(o) 260,971	.....	1,457,715	(o) 306,845	.....	1,693,855	10
(m) 443,000	(m) 443,000	2,399,584	426,260	.....	2,199,210	(m) 389,548	.....	2,009,566	(m) 348,220	1,812,642	318,390	.....	1,696,605	329,506	.....	1,650,408	348,324	.....	1,868,195	11
(m) 494,745	.....	2,385,189	(m) 487,000	.....	2,176,846	(m) 440,000	(m) 354,000	1,792,111	(m) 410,000	1,641,749	403,100	300,000	1,765,737	405,400	334,300	1,649,583	412,000	322,000	1,768,184	12
(o) 526,500	.....	2,373,707	(o) 529,400	.....	2,321,187	498,600	421,500	2,188,887	472,700	1,987,776	(o) 451,900	.....	2,011,436	(o) 467,300	.....	2,032,576	(o) 484,000	.....	1,987,328	13
(o) 505,900	(o) 496,900	2,347,861	491,900	410,500	2,261,068	(o) 408,120	(o) 406,200	1,942,586	(o) 391,340	1,719,798	(o) 390,720	.....	1,601,050	389,120	343,400	1,406,940	(o) 402,810	.....	1,860,806	14
(o) 361,100	(o) 291,100	1,870,625	(o) 342,900	(o) 330,780	1,642,301	(o) 325,909	(o) 286,640	1,445,556	(o) 282,500	1,206,989	(o) 284,860	.....	1,252,193	(o) 275,660	(o) 268,170	1,163,108	270,000	.....	1,319,011	15
(o) 335,500	(o) 335,500	1,848,643	(o) 334,000	(o) 334,000	1,320,075	(o) 328,500	(o) 328,500	1,429,694	(o) 293,900	1,216,669	(o) 256,800	(o) 256,800	1,314,265	(o) 222,100	(o) 222,100	933,431	(o) 126,500	(o) 126,500	506,219	16
(o) 360,100	(o) 348,300	1,836,112	.....	367,000	1,644,712	(m) 295,000	(m) 295,000	1,403,253	(m) 270,000	1,331,858	264,000	264,000	1,211,956	245,000	245,000	1,176,869	289,000	289,000	1,364,319	17
345,000	266,800	1,778,250	(o) 348,800	(o) 262,200	1,730,569	(o) 304,800	.....	1,522,749	(o) 310,000	1,482,349	(o) 280,100	(o) 198,940	1,402,223	(o) 281,600	(o) 229,200	1,382,588	(o) 291,600	(o) 231,200	1,483,177	18
(j) 360,223	(j) 362,223	1,707,031	353,868	354,868	1,641,551	333,782	333,782	1,457,969	307,828	1,341,906	309,392	.....	1,240,542	283,900	.....	1,201,175	309,556	.....	1,316,116	19
(o) 372,900	(o) 333,460	1,691,884	(o) 329,901	(o) 300,677	1,490,798	(o) 281,878	(o) 257,531	1,233,812	(o) 221,330	1,067,120	(o) 210,467	.....	928,828	237,343	197,592	894,760	242,700	.....	1,016,384	20
(o) 258,500	(o) 255,500	1,559,436	243,300	243,300	1,496,867	(o) 203,400	.....	1,292,318	(o) 169,500	1,011,018	159,600	159,600	889,321	119,700	119,700	613,026	145,700	145,700	937,014	21
324,200	.....	1,510,463	308,000	.....	1,438,882	308,530	.....	1,252,490	257,860	1,121,784	261,000	.....	1,045,236	249,900	.....	1,072,227	266,540	.....	1,162,409	22
(r) 300,000	(o) 144,000	(g) 1,508,886	(r) 285,200	(o) 167,000	(g) 1,328,131	(r) 244,300	(o) 102,500	(g) 1,113,560	(r) 209,600	(g) 994,509	(r) 198,000	(o) 74,200	(g) 897,675	(o) 180,400	(o) 119,900	843,523	(o) 181,500	(o) 162,500	884,251	23
343,061	.....	1,506,345	300,976	.....	1,366,641	(m) 262,718	.....	1,210,496	(m) 227,410	1,070,722	221,693	.....	974,871	231,969	.....	971,761	261,322	.....	1,125,840	24
366,500	366,500	1,506,171	(m) 230,300	(m) 221,300	928,501	183,200	108,300	798,262	171,300	744,454	159,600	95,500	712,102	167,400	94,500	722,331	169,000	84,700	759,029	25
278,374	.....	1,319,245	.....	(s) 252,534	1,246,345	(m) 243,534	.....	1,098,472	225,448	1,029,300	.....	.....	963,928	204,461	.....	974,484	227,971	.....	1,064,003	26
(o) 243,100	(o) 236,000	1,280,943	(o) 227,700	(o) 220,800	1,128,925	(o) 179,600	(o) 174,500	876,900	(o) 163,000	799,541	(o) 145,200	.....	715,770	(o) 153,000	(o) 134,700	693,551	.....	.....	849,713	27
(o) 228,200	(o) 193,800	(p) 1,278,809	(o) 189,700	(o) 178,840	1,005,193	(o) 170,720	.....	854,380	(o) 143,420	762,886	118,785	118,785	634,984	128,135	128,135	647,596	(o) 152,420	(o) 152,420	784,134	28
(m) 305,430	(m) 249,040	1,274,633	(m) 320,966	(m) 278,000	1,266,045	(m) 321,842	(m) 251,000	1,224,563	(m) 288,545	1,112,072	283,595	219,000	1,073,311	265,563	213,000	1,048,824	281,787	231,210	1,048,606	29
(m) 232,410	(m) 230,635	(g) 1,233,901	(m) 219,240	(m) 214,440	1,044,906	(m) 205,435	(m) 202,635	914,812	(m) 192,568	851,144	179,795	170,295	788,482	177,255	148,763	824,481	185,630	.....	911,955	30
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
319,200	319,200	1,166,681	162,000	162,000	120,884	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
(o) 273,280	(o) 198,320	1,035,987	(o) 236,160	(o) 196,040	1,045,704	(o) 237,360	.....	1,059,547	(o) 239,720	1,103,009	(o) 234,250	(o) 170,920	966,328	(o) 208,600	(o) 178,750	814,271	(o) 217,000	(o) 171,300	731,648	32
(o) 189,000	(o) 155,500	1,016,041	(o) 189,000	(o) 115,000	952,523	(o) 152,900	(o) 85,900	782,935	(o) 130,000	721,676	(o) 110,300	.....	575,047	145,740	106,260	536,914	165,000	.....	762,529	33
(o) 186,300	(o) 174,400	952,593	(o) 176,300	(o) 163,300	867,951	(o) 170,400	(o) 153,200	795,378	(o) 148,400	.....	(o) 147,900	(o) 138,300	713,138	(o) 143,860	(o) 125,590	664,678	(o) 151,870	(o) 151,870	706,351	34
147,200	133,630	919,184	143,260	126,880	736,702	(o) 115,160	.....	564,307	(o) 95,510	518,737	90,710	66,340	476,412	103,710	67,160	493,678	119,390	100,500	650,549	35
(o) 189,000	(o) 154,000	835,168	(t) 179,000	(u) 152,000	778,927	(m) 169,000	.....	725,464	(m) 164,000	662,833	148,000	.....	562,433	137,000	137,000	542,528	130,000	130,000	519,295	36
(o) 171,837	(o) 84,100	819,824	(o) 157,400	(o) 105,010	726,324	(o) 140,855	(o) 85,282	651,928	(o) 136,855	614,087	(o) 142,833	(o) 63,478	586,652	(o) 134,058	(o) 47,540	555,314	(o) 135,664	(o) 55,220	590,529	37
137,610	82,300	811,820	123,210	82,470	603,143	88,016	.....	463,600	75,160	409,796	70,450	.....	403,796	72,600	70,000	373,324	76,650	.....	423,230	38
158,650	117,500	774,931	152,560	114,500	764,850	131,870	108,700	642,608	120,900	580,038	118,450	100,300	530,805	116,980	.....	533,569	72,588	40,775	320,594	39
.....	96,000	760,703	113,262	96,000	793,819	(o) 105,428	.....	572,219	(o) 106,377	583,409	110,188	97,000	530,645	112,988	103,000	551,155	112,091	96,151	612,119	40
151,700	151,700	757,407	135,100	135,100	721,326	(c) 132,400	(c) 129,900	652,655	(c) 126,200	626,909	.....	120,600	596,988	128,200	.....	615,731	131,000	.....	629,935	41
154,872	129,935	748,186	(o) 149,504	(o) 124,443	700,104	(o) 137,053	.....	632,021	(o) 116,716	565,072	(o) 116,719	.....	557,825	(o) 114,425	.....	536,776	(o) 115,241	.....	552,060	42
(o) 144,000	(o) 140,000	704,759	(o) 145,000	(o) 141,000	659,643	(o) 130,000	(o) 128,000	583,071	(o) 118,000	541,575	(o) 109,000	(o) 109,000	496,188	(o) 108,300	(o) 126,000	514,790	(o) 130,900	(o) 130,400	603,182	43
125,096	124,104	691,821	.....	97,689	588,952	(m) 97,689	(m) 97,689	507,656	(m) 89,270	462,518	83,678	80,178	429,122	83,152	.....	430,352	99,494	95,530	489,175	44
(o) 133,200	(o) 133,900	664,860	(o) 127,600	(o) 127,300	605,218	110,500	.....	531,015	102,900	520,750	102,400	92,000	506,713	104,200	97,500	507,496	107,600	.....	534,629	45
(o) 121,200	(o) 117,300	659,912	(o) 110,000	(o) 110,400	591,679	(o) 99,800	.....	517,942	(o) 90,000	482,255	83,000	80,900	442,468	(o) 82,600	(o) 79,500	435,971	(o) 96,210	(o) 93,100	524,913	46
~~129,100~~	~~97,900~~	~~624,774~~	111,800	100,200	577,089	104,500	86,600	453,089	95,000	437,060	(o) 95,900	(o) 65,700	408,608	(o) 90,300	(o) 56,200	395,240	(o) 103,200	(o) 71,000	455,841	47
(o) 92,302	(o) 86,085	609,466	(o) 81,797	(o) 78,667	517,962	(o) 69,680	.....	434,959	(o) 66,756	429,712	(o) 71,774	(o) 66,030	402,652	(o) 74,916	(o) 65,700	391,999	(o) 68,857	(o) 66,440	450,865	48
(o) 125,610	(o) 104,480	588,397	(o) 112,850	(o) 101,680	535,205	(o) 89,200	.....	448,880	(o) 91,000	444,191	(o) 101,630	(o) 82,240	482,671	(o) 102,540	(o) 82,630	435,440	(o) 105,225	(o) 89,890	445,325	49
110,980	106,175	575,585	.....	106,252	553,827	98,950	98,950	515,252	86,940	488,083	83,565	80,800	478,307	84,700	81,795	471,472	92,425	81,760	465,157	50
116,020	108,020	551,993	109,000	98,000	523,217	98,000	87,000	492,963	91,120	430,527	(o) 87,000	(o) 86,792	412,112	(o) 95,400	(o) 81,000	389,780	(o) 107,030	(o) 95,000	452,179	51
101,900	100,200	536,254	(o) 104,660	.....	512,988	89,640	88,061	459,906	91,740	448,792	90,205	85,070	405,825	(o) 85,750	.....	361,975	(o) 88,070	.....	440,668	52
87,700	87,700	506,712	83,500	83,500	514,179	83,700	83,700	507,978	83,600	502,306	84,600	84,600	469,418	83,600	83,600	507,324	83,600	83,600	309,450	53
(o) 110,475	(o) 68,975	496,414	82,000	67,000	370,930	62,000	62,000	260,516	49,070	218,535	49,070	49,070	218,535	43,075	43,075	191,952	.....	63,160	292,324	54
(o) 160,400	(o) 160,400	494,799	213,500	213,500	770,639	180,000	180,000	386,600	133,000	200,352	121,000	121,300	287,862	128,000	136,000	286,638	161,634	162,034	345,603	55
(o) 86,000	.....	494,773	91,000	.....	461,609	85,600	.....	460,014	78,100	430,668	74,800	.....	412,011	76,700	.....	433,146	86,100	85,100	443,000	56
(o) 139,700	(o) 139,700	484,269	(o) 137,700	(o) 137,700	461,353	127,700	127,700	419,332	(o) 130,300	389,470	(o) 131,000	(o) 131,000	463,031	(o) 117,700	(o) 117,700	397,765	(o) 123,900	(o) 123,900	425,908	57
(o) 83,988	(o) 83,369	477,809	(o) 88,422	(o) 87,900	401,644	(o) 75,383	.....	357,959	(o) 77,957	349,105	(o) 77,600	(o) 77,600	320,440	(o) 83,622	(o) 82,152	452,534	(o) 86,190	(o) 82,720	521,669	58
91,150	90,070	475,274	(o) 88,560	(o) 88,160	440,969	(o) 83,472	(o) 83,370	400,303	(o) 79,560	381,226	(o) 72,980	(o) 70,080	358,792	(o) 74,820	(o) 73,800	370,583	(o) 84,300	(o) 84,000	411,565	59
110,000	110,000	472,852	94,750	83,750	421,305	82,150	81,450	360,489	72,100	321,135	.....	.....	.....	.....	.....	.....	.....	.....	.....	

47	The Ohio Public Service Company		129,100		97,900		824,774		111,800		100,200		577,089		104,500		88,000		455,689		93,000		437,000		95,900		63,700		408,608		90,300		56,2
48	Idaho Power Company (*P*)	(o)	92,302	(o)	86,085		609,466	(o)	81,797	(o)	78,667		517,962	(o)	69,680		.....		434,959	(o)	66,756		429,712	(o)	71,774	(o)	66,030		402,652	(o)	74,916	(o)	65,2
49	Texas Power & Light Co. (*P*)	(o)	125,610	(o)	104,480		588,397	(o)	112,850	(o)	101,680		535,205	(o)	89,200		.....		448,880	(o)	91,000		444,191	(o)	101,630	(o)	82,240		482,671	(o)	102,540	(o)	82,6
50	The California Oregon Power Company		110,980		106,175		575,585		.....		106,252		553,827		98,950		98,950		515,252		86,940		488,083		83,565		80,800		478,307		84,700		81,7
51	The Toledo Edison Company		116,020		108,020		551,993		109,000		98,000		523,217		98,000		87,000		492,963		91,120		430,527	(o)	87,000	(o)	86,792		412,112	(o)	95,400	(o)	81,0
52	Central Maine Power Company		101,900		100,200		536,254	(o)	104,660		.....		512,988		89,640		88,061		459,906		91,740		448,792		90,205		85,070		405,825	(o)	85,750		.....
53	Hetch Hetchy Water Supply, San Francisco		87,700		87,700		506,712		83,500		83,500		514,179		83,700		83,700		507,978		83,600		502,306		84,600		84,600		469,418		83,600		83,6
54	Salt River Valley Water Users' Association	(o)	110,475	(o)	68,975		496,414		82,000		67,000		370,930		62,000		62,000		260,516		49,070		218,535		49,070		49,070		218,535		43,075		43,0
55	Tennessee Valley Authority	(o)	160,400	(o)	160,400		494,799		213,500		213,500		770,639		180,000		180,000		386,600		133,000		200,352		121,000		121,300		287,862		128,000		136,0
56	Western Mass. Companies and Its Constituent Cos	(o)	86,000		.....		494,773		91,000		.....		461,609		85,600		.....		460,014		78,100		430,668		74,800		.....		412,011		76,700		.....
57	South Carolina Elec. & Gas Corp. and Lexington W. P. Co.*	(o)	139,700	(o)	139,700		484,269	(o)	137,700	(o)	137,700		461,353		127,700		127,700		419,332	(o)	130,300		389,470	(o)	131,000	(o)	131,000		463,031	(o)	117,700	(o)	117,7
58	Texas Electric Service (*P*)	(o)	83,988	(o)	83,369		477,809	(o)	88,422	(o)	87,900		401,644	(o)	75,383		.....		357,959	(o)	77,957		349,105	(o)	77,600	(o)	77,600		320,440	(o)	83,622	(o)	82,0
59	Pennsylvania Electric Company and Affiliates *		91,150		90,070		475,274	(o)	88,560	(o)	88,160		440,969	(o)	83,472	(o)	83,370		400,303	(o)	79,560		381,226	(o)	72,980	(o)	70,080		358,792	(o)	74,820	(o)	73,4
60	Indianapolis Power & Light Company		110,000		110,000		472,852		94,750		83,750		421,305		82,150		81,450		360,489		72,100		321,135		.....		.....		297,288		.....		.....
61	Public Service Company of Colorado	(o)	95,310	(o)	94,000		472,369	(o)	89,690	(o)	88,260		416,804	(o)	79,320	(o)	78,260		354,296	(o)	71,950		320,256	(o)	64,085	(o)	64,085		285,823	(o)	66,562		.....
62	Rochester Gas and Electric Corporation	(o)	95,803	(o)	86,560		461,273	(o)	87,179	(o)	71,700		415,012	(o)	80,147	(o)	54,500		384,512	(o)	75,729		362,468	(o)	67,950	(o)	48,704		331,452	(o)	68,378	(o)	60,7
63	Minnesota Power & Light Company (*P*)	(o)	93,208	(o)	93,208		460,171	(o)	90,341	(o)	90,341		459,591	(o)	90,225		.....		407,968	(o)	72,669		321,952	(o)	64,513	(o)	64,513		306,677	(o)	70,735	(o)	70,7
64	Central Illinois Public Service Company		112,400		65,400		459,167		106,500		63,400		421,145		87,200		52,300		368,718		83,200		319,614		72,200		42,000		302,561		86,000		.....
65	Arkansas Power & Light Company (*P*)		88,541		69,400		452,466	(o)	81,700	(o)	68,000		391,061	(o)	55,300		.....		346,829	(o)	55,200		318,656	(o)	55,466	(o)	52,000		295,801		63,000		25,0
66	New Orleans Public Service Inc.(*P*)	(r)	85,000	(r)	105,000		444,434		96,000		96,000		416,139	(o)	79,000		.....		339,545	(o)	69,500		307,693		72,000		72,000		296,420		70,000		63,0
67	Northwestern Electric Company (*P*)	(o)	82,600	(o)	51,200		439,684		75,786		.....		384,310	(o)	80,227		.....		351,536	(o)	68,529		322,381	(o)	63,198	(o)	44,296		266,944	(o)	55,150	(o)	37,0
68	The Nevada-California Electric Corporation		77,800		74,200		439,237		74,400		58,300		400,128		65,700		58,500		355,878		61,300		348,922		54,400		51,500		300,679		56,900		54,0
69	Louisville Gas and Electric Co. (Kentucky)	(m)	109,030		109,000		434,964		.....		126,330		475,854	(m)	81,448	(m)	80,540		423,211	(m)	77,530		420,498		.....		.....		394,982		.....		.....
70	The Hartford Electric Light Company		100,700		103,300		424,016		102,300		90,800		475,956		88,900		86,000		341,336		78,700		308,368		75,300		84,400		289,961		70,500		67,0
71	City of Seattle — Department of Lighting	(m)	103,000	(m)	103,000		419,977	(m)	104,000		104,000		387,637		88,000		80,000		349,967		85,000		341,282		83,000		73,000		321,750		87,500		87,0
72	Columbus and Southern Ohio Electric Company *	(o)	81,000	(o)	81,000		419,604	(o)	78,700	(o)	78,700		361,293	(o)	70,000	(o)	70,000		316,027	(o)	63,100		295,613	(o)	59,300	(o)	59,300		261,859	(o)	55,000	(o)	55,0
73	Nebraska Power Company (*P*)	(o)	81,600	(o)	81,600		397,621		.....	(m)	81,500		393,795	(o)	74,280		.....		354,800	(o)	68,950		348,495	(o)	64,500	(o)	64,500		314,903	(o)	63,400	(o)	63,0
74	Central Illinois Light Company	(o)	77,716	(m)	76,300		381,249	(o)	73,005	(o)	75,900		356,041	(m)	62,667	(m)	59,700		291,345	(m)	52,443		269,167	(o)	64,230		.....		248,225	(o)	32,791		.....
75	City of Tacoma (Light Dept.)	(o)	69,000	(o)	78,000		374,838	(o)	62,000	(o)	71,000		312,663	(o)	55,000	(o)	67,000		276,098	(o)	54,000		244,650		50,000		50,000		229,620		51,000		63,0
76	The United Illuminating Company		.....	(h)	86,900		372,354		.....	(o, h)	87,600		349,324		.....	(o, h)	78,700		308,338	(o, h)	70,000		277,337		.....		.....		263,259		.....		.....
77	Gulf States Utilities Company	(o)	70,441	(o)	70,019		367,401	(o)	58,330	(o)	56,955		292,270	(o)	49,285	(o)	42,770		258,442	(o)	49,215		244,947		42,314		35,400		224,411		44,958		38,4
78	Montaup Electric Company		101,900		74,650		368,319		.....		.....		.....		98,700		75,850		423,657		94,400		368,718		100,800		77,860		407,000		91,600		77,0
79	Kentucky Utilities Company		65,900		51,400		360,061		64,300		52,600		352,544		61,800		54,800		323,462		62,800		284,176		51,000		47,000		268,975		60,800		55,0
80	Florida Power & Light Company (*P*)	(o)	93,800	(o)	93,470		341,281	(o)	83,120	(o)	82,740		294,291	(o)	73,874		.....		249,184	(o)	63,046		217,589		56,700		55,900		191,185		59,180		57,0
81	Long Island Lighting System		97,200		97,200		339,369		86,500		86,500		308,572		83,500		83,500		283,939		82,000		272,402		77,400		77,400		258,342		76,000		76,0
82	Wisconsin Power and Light Company		70,100		68,750		326,457		67,950		65,975		309,384		64,100		60,165		287,193		65,048		271,322		53,290		43,290		252,759		64,850		61,0
83	Pacific Power & Light Company (*P*)	(m)	54,550		.....		320,128		48,940		.....		256,712	(o)	60,290		.....		243,266	(o)	59,415		242,425		40,695		19,765		173,931		57,705		15,0
84	Kansas Gas and Electric Company (*P*)	(o)	57,500	(o)	57,300		319,946		57,000		57,000		299,415	(o)	51,900		.....		265,794	(o)	48,400		240,481		46,000		46,000		225,142		49,000		49,0
85	Wisconsin Public Service Corp. and Subsidiary	(o)	64,888	(o)	64,888		317,890		.....		65,400		297,258		51,650		.....		258,398		62,200		259,125	(o)	61,100	(o)	51,300		255,943	(o)	44,600	(o)	44,0
86	The Connecticut Power Company		.....		.....		312,502		.....		.....		276,762		38,500		11,000		147,737		40,200		151,903		28,380		11,040		143,905		25,700		14,0
87	Jersey Central Power and Light Company		69,200		74,500		312,040	(m)	66,000	(m)	70,000		271,993	(m)	58,700	(m)	67,600		242,095	(m)	56,100		218,586		52,600		54,000		202,882		52,200		61,0
88	The Empire District Electric Company	(m)	57,400	(m)	57,400		310,102	(m)	52,200	(m)	52,200		287,065		.....	(m)	50,000		240,380	(m, n)	44,100		205,059	(o)	38,900	(o)	38,900		179,267	(o)	33,1 0	(o)	33,0
89	Dallas Power & Light Company (*P*)	(o)	68,000	(o)	68,000		308,008	(o)	78,300	(o)	78,300		290,990	(o)	54,300		.....		240,614	(o)	50,600		228,578	(o)	48,300	(o)	48,000		210,132	(o)	49,300	(o)	49,0
90	Birmingham Electric Company (*P*)	(o)	56,198		.....		304,740		52,588		.....		279,557	(o)	45,712		.....		230,824	(o)	42,310		215,160	(o)	37,983		.....		196,012		41,196		.....
91	Pennsylvania Edison Company *	(o)	66,700	(o)	66,600		301,486	(o)	61,650	(o)	61,600		291,435	(o)	54,966	(o)	54,834		253,757	(o)	51,095		236,072		.....		49,500		219,733		.....		47,0
92	The Scranton Electric Company	(o)	59,700	(o)	59,700		299,760	(o)	59,800	(o)	59,800		316,188	(o)	59,600	(o)	59,600		276,436	(o)	56,200		257,257		52,000		52,000		239,667		51,200		51,0
93	Southwestern Gas and Electric Company		49,762		34,100		296,354		41,500		33,700		248,514	(o)	41,680	(o)	32,940		220,277	(o)	39,120		211,394		41,500		32,000		207,267		32,400		28,0
94	Atlantic City Electric Company	(o)	68,500	(o)	68,500		296,238	(o)	62,100	(o)	62,100		268,396	(o)	49,700	(o)	49,700		223,615	(o)	47,700		204,238		46,700		46,700		193,920		49,500		49,0
95	Virginia Public Service Company	(o)	61,200	(o)	58,600		294,871	(o)	67,900	(o)	66,500		280,473		56,200		55,000		246,838		50,900		227,847		51,200		49,700		217,015		49,400		47,0
96	West Texas Utilities Company	(o)	54,900		.....		293,348		50,200		.....		275,227		49,150		.....		229,654		39,350		216,019		41,155		38,300		199,494		47,660		.....
97	Louisiana Steam Generating Corp		.....		.....		293,082	(o)	45,000	(o)	45,000		273,166		.....	(m)	36,000		234,398	(m)	29,000		171,572		.....		.....		.....		.....		.....
98	Central Power and Light Company (Texas)		60,820		50,255		287,744		49,205		9,150		239,433		39,540		28,280		209,740		.....		201,831		37,485		30,000		197,390		33,095		30,0
99	Public Service Company of New Hampshire	(o)	62,905	(o)	60,805		278,351	(o)	60,040	(o)	59,940		240,785	(o)	52,730	(o)	45,130		219,206	(o)	49,565		206,863	(o)	46,760	(o)	44,960		188,639	(o)	47,705	(o)	46,0
100	Public Service Company of Oklahoma		55,000		48,500		272,179		48,300		43,000		241,977		45,000		39,500		218,847		40,600		207,200		37,700		34,000		189,364		39,030		34,0
101	Inland Power & Light Company (*P*)	(o)	51,560	(o)	51,560		267,172		50,615		50,615		227,924	(o)	50,655		.....		191,918	(o)	50,635		180,575		.....		.....		.....		.....		.....
102	Pennsylvania Power Company	(o)	51,870		.....		264,098	(o)	45,000		.....		227,998	(o)	40,000		.....		177,678	(o)	34,200		155,229	(o)	31,000		.....		141,136		34,000		.....
103	Memphis Power & Light Company (*P*)	(o)	59,180	(o)	55,100		264,038	(o)	51,800	(o)	51,800		226,192	(o)	46,500		.....		197,482	(o)	45,100		189,445	(o)	40,000	(o)	40,000		169,072		40,500		40,0
104	Central Hudson Gas & Electric Corporation	(o)	48,600	(d, o)	46,500		244,549	(o)	59,900	(d, o)	41,600		227,597	(o)	45,500	(o)	41,100		216,374	(o)	45,200		205,895		77,900	(d)	31,800		245,117		82,200	(d)	34,0
105	Des Moines Electric Light Company		.....		54,000		244,105		.....		50,000		225,006		.....		45,000		206,359		44,000		196,009		43,600		43,600		178,667		40,000		40,0
106	San Diego Consolidated Gas & Electric Company		59,800		56,800		235,657		56,500		59,500		231,925		.....		60,500		205,338		46,000		183,773		44,650		50,500		178,033		44,700		44,0
107	San Antonio Public Service Company		59,629		53,729		231,222	(o)	54,948		.....		204,457	(o)	38,262	(o)	28,762		178,992	(o)	42,167		171,542	(o)	35,677	(o)	29,877		165,681		42,300		34,9
108	Northern Indiana Power Company		47,390	(w)	7,500		227,974		43,820		7,400		199,081		41,150		12,200		177,112		36,100		147,206	(o)	41,540		1,620		138,628		36,300		.....
109	New Bedford Gas & Edison Light Company	(o)	56,800	(o)	56,800		226,963	(o)	52,500	(o)	52,500		214,933	(o)	48,400	(o)	48,400		196,172	(o)	48,000		183,658	(o)	48,300	(o)	48,300		179,947	(o)	44,200	(o)	44,2
110	City of Detroit, Public Lighting Commission	(x)	53,000	(x)	48,000	(x)	219,995		56,605		52,150		215,382		55,300		49,000		203,624		51,600		205,513		50,000		43,500		183,044		52,000		46,2
111	Mississippi Power & Light Company (*P*)	(o)	49,459	(o)	5,560		219,639	(o)	43,189	(o)	7,590		196,645	(o)	37,618		.....		164,465	(o)	35,030		147,368		32,464		.....		132,668		30,372		.....
112	Blackstone Valley Gas and Electric Company	(o)	54,488		.....		214,399		53,749		.....		230,166		54,082		.....		213,155		49,948		177,429		53,676		.....		200,349	(o)	47,628	(o)	18,0
113	Sioux City Gas & Elec. Co.— Iowa Public Service Co. System		51,010		48,735		214,236		48,000	(o)	46,200		208,170	(o)	43,779	(o)	41,355		179,573	(o)	41,893		169,705		36,356		34,515		152,803		34,428		25,4
114	Cumberland County Power and Light Company	(o)	42,280	(o)	26,280		213,039	(o)	45,720	(o)	31,720		192,698	(o)	52,640	(o)	38,640		169,875	(o)	54,860		159,273		38,300		27,800		159,328		39,100		26,0
115	The Sanitary District of Chicago	(o)	40,130	(o)	22,967		212,568		40,300		22,800		200,947		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....
116	City of Cleveland, Dept. of Public Utilities		41,000		41,000		205,752		42,400		42,400		184,834		.....		39,350		168,595		38,100		163,919		.....		.....		.....		.....		.....
117	Delaware Power & Light Company	(o)	37,810	(o)	11,500		203,499		35,034		.....		172,131		29,265		.....		142,732		25,989		128,066		25,548		.....		120,052		26,931		.....
118	Indiana Service Corporation		46,100		24,000		201,481		41,200		27,000		184,776		38,200		20,000		147,493		32,400		140,333		28,000		8,700		130,083		28,200		20,0
119	Interstate Power Company (Del.) and Subs		46,707		38,052		184,787		44,447		35,492		173,233		42,120		30,515		146,821		39,115		142,754		.....		.....		128,431		.....		.....
120	Florida Power Corporation	(o)	43,100	(o)	42,100		180,210	(o)	30,500	(o)	23,000		138,066		29,000		.....		122,755		25,500		105,601		23,300		23,300		95,227		26,700		26,0
121	Iowa Electric Light and Power Company		40,922		40,922		178,822		38,462		38,462		167,054		32,505		32,505		144,433		30,065		136,293		28,825		28,825		126,075		31,225		31,2
122	Tampa Electric Company		39,400		38,400		176,837		35,000		35,000		163,243		36,600		36,600		154,576		34,800		153,003		33,000		33,000		143,553		28,200		28,0
123	Mississippi Power Company	(o)	33,397	(o)	5,900		174,344	(o)	29,455	(o)	5,500		146,009	(o)	26,373	(o)	5,009		118,302	(o)	23,010		106,307	(o)	22,134		.....		104,020		25,305		4,0
124	Turlock-Modesto Irrigation Districts	(o)	40,560	(o)	40,560		174,312		39,560		39,560		158,258		38,650		38,650		153,918		34,400		132,048		.....		.....		.....		.....		.....
125	South Carolina Power Company	(o)	29,000	(o)	29,000		163,881	(o)	30,800	(o)	25,700		138,394	(o)	28,100	(o)	28,100		128,470	(o)	27,500		124,682	(o)	29,700		.....		101,505	(o)	26,100	(o)	26,0
126	Tennessee Public Service Company (*P*)	(o)	29,832	(o)	88		157,815	(o)	28,173	(o)	106		137,093	(o)	24,256		.....		113,954	(o)	20,899		98,138		18,681		100		90,238		20,030		.....
127	Iowa-Nebraska Light and Power Company	(o)	34,200	(o)	28,180		144,924	(o)	32,600		.....		141,706		29,720		20,620		125,267		28,200		118,863		.....		.....		.....		.....		.....
128	Kansas City, Kan., Board of Public Utilities	(o)	29,400	(o)	29,400		144,708	(o)	27,500	(o)	27,500		135,366		25,500		25,500		123,565		26,200		120,909		.....		.....		.....		.....		.....
129	Southern Indiana Gas and Electric Company	(o)	35,500	(o)	35,500		143,260	(o)	34,200	(o)	34,200		128,476	(m)	28,000	(m)	28,000		105,157	(m)	23,000		91,209		.....		.....		.....		.....		.....
130	Laclede Power & Light Company	(m)	32,200	(m)	26,000		140,282		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....
131	Luzerne County Gas and Electric Corporation	(o)	26,470	(o)	44,670		139,909	(o)	27,600	(o)	40,800		142,525	(o)	24,660	(o)	42,800		131,136	(o)	25,120		132,627		26,800		35,600		134,761		26,710		39,0
132	City of Lansing, Board of Water and Electric Light Comm'rs		37,271		27,271		139,612		32,930		32,930		121,838		30,050		30,050		107,685		22,345		87,997		.....		.....		.....		.....		.....
133	Merced Irrigation District		31,500		31,500		138,970		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....
134	Washington Gas and Electric Company		29,697		27,291		138,952		27,800		25,500		135,884		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....
135	El Paso Electric Company		.....		26,600		137,294		26,200		26,200		117,178	(m)	23,500	(m)	23,500		103,777	(m)	22,000		95,558		19,000		19,000		85,027		19,900		19,0
136	Bangor Hydro-Electric Company	(o)	24,460	(o)	24,460		136,455	(o)	26,040	(o)	26,040		137,847		25,510		25,510		120,091		25,350		97,750	(o)	26,700	(o)	26,700		102,703	(o)	21,970	(o)	21,0
137	Jacksonville Municipal Light Plant		31,800		31,800		134,730		.....	(m)	30,900		117,319	(m)	25,500	(m)	25,500		103,750	(m)	24,800		93,528		.....		.....		.....		.....		.....
138	Staten Island Edison Corporation	(o)	31,700	(o)	31,700		130,148	(o)	31,000	(o)	30,600		122,733	(o)	29,000		28,500		115,165		.....		.....		.....		.....		.....		.....		.....		.....

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Supplement to ELECTRICAL WORLD, May 7, 1938
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For explanations and comments relating to these statistics the *Electrical World* of May 7, 1938, should be consulted.

Table II—Detailed Data on Generator Rating, Output, Customers and Distribution of E of Public Utility Systems Having an Output Exceeding 100,000,000 Kw.-Hr. During

Line No.	Section and System	Generator Rating, Dec. 31, 1937				Source of Energy, 1937			Disposal of Energy					Distribution of Sales to Ultimate Consumers in Kilowatt-Hours								D
		Fuel Burning Plants		Hydro Plants																		
		No. of Plants	Rating of Generators, Kw.	No. of Plants	Rating of Generators, Kw.	Total Input (Net), Kw.-Hr.	Generated (Net), Kw.-Hr.	Received by Purchase or Interchange (Net), Kw.-Hr.	Used by Elec. Ry. Dept., Kw.-Hr.	Used by Elec. and Other Depts., Kw.-Hr.	Lost and Unaccounted For, Kw.-Hr.	To Other Public Utilities, Kw.-Hr.	Sales to Ultimate Consumers, Kw.-Hr.	Farm, or Farm and Rural	Domestic Service	Commercial Small Light and Power (Retail)	Commercial Large Light and Power (Wholesale)	Municipal Street Lighting, etc.	Railways & Electrified Railroads	Other Sales to Ultimate Consumers	Farm or Rural	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	
	New England States																					
1	New England Power Association (Consolidated)	18	391,630	27	327,680	2,373,707,292	2,015,180,468	358,526,824	29,843,754	57,452,898	315,078,643	601,927,210	1,369,404,787	(f)	f 256,400,998	150,162,568	904,101,575	41,508,880	17,230,766	0	(f)	f
2	Boston Edison Company	2	358,860	2	300	1,274,632,523	1,092,537,385	182,095,138	0	13,924,497	171,785,974	238,199,639	850,722,413	5,006,467	225,363,931	201,791,389	367,273,372	35,019,544	16,267,710	0	a 2,487	a
3	The Connecticut Light and Power Company	2	130,000	12	66,815	748,186,164	609,043,693	139,142,471	0	7,582,452	93,910,314	118,631,430	528,061,968	(f)	f 127,742,071	50,667,373	316,283,050	10,577,100	22,792,374	0	(f)	f
4	Central Maine Power Company	4	18,572	23	107,350	536,254,451	515,342,221	20,912,230	H 4,690,840	44,339,375	70,014,557	48,419,765	368,789,914	6,978,176	38,432,638	24,729,298	283,555,537	4,469,374	4,291,889	6,333,002	10,097	
5	Western Mass. Companies and its Constituent Cos.	3	61,000	8	99,750	494,773,000	o 386,983,000	o 107,790,000	0	5,827,000	67,907,000	94,231,000	326,808,000	(f)	f 60,070,000	45,832,000	195,431,000	8,862,000	15,135,000	l 1,478,000	(f)	f
6	The Hartford Electric Light Company	2	124,000	1	1,500	424,015,650	397,563,850	26,451,800	0	5,969,072	26,914,592	146,774,041	244,357,945	(f)	f 73,386,388	71,205,072	76,216,448	7,933,637	15,616,400	0	(f)	a, f
7	The United Illuminating Company	2	160,000	0	0	372,354,300	372,354,300	0	0	1,317,388	37,821,679	12,224,000	320,991,233	(f)	f 69,596,760	66,676,935	177,019,036	7,698,502	0	0	(f)	f
8	Montaup Electric Company	1	75,000	0	0	368,319,073	351,444,930	16,874,143	0	0	0	368,319,073	0	0	0	0	0	0	0	0	0	
9	The Connecticut Power Company	1	38,740	2	10,760	312,501,944	159,647,970	152,853,974	0	3,365,215	26,898,885	143,317,599	138,920,245	(f)	f 46,282,874	19,762,675	69,019,799	3,854,897	0	0	(f)	a, f
10	Public Service Company of New Hampshire	5	43,535	32	63,474	278,350,995	269,304,764	9,046,231	435,297	5,111,092	36,671,286	81,404,381	154,728,939	5,912,839	30,703,515	18,778,170	88,747,915	4,974,384	3,426,740	2,185,376	7,311	
11	New Bedford Gas & Edison Light Company	1	92,000	0	0	226,962,770	226,962,770	0	0	2,321,483	18,538,223	32,667,400	173,435,664	731,022	16,736,471	10,783,309	141,202,672	2,940,265	0	1,041,925	488	
12	Blackstone Valley Gas and Electric Company	1	33,500	4	1,850	214,398,897	35,348,372	179,050,525	0	1,423,678	25,126,927	5,169,412	182,678,880	(f)	f 21,624,106	16,526,765	137,616,795	2,993,973	0	3,917,241	(f)	f
13	Cumberland County Power and Light Company	2	36,000	9	25,172	213,038,940	171,777,540	41,261,400	10,987,262	3,270,750	28,097,557	14,039,700	156,643,671	1,372,436	27,224,736	22,914,770	99,588,238	3,713,099	764,200	1,066,192	1,683	
14	Bangor Hydro-Electric Company	0	0	12	31,035	136,455,181	136,390,381	64,800	2,670,640	1,068,160	21,919,204	1,948,460	108,848,717	(f)	f 16,419,400	12,388,591	78,562,635	1,215,491	0	l 262,600	0	
15	Cambridge Electric Light Company	1	23,950	0	0	119,020,117	91,839,800	27,180,317	0	1,243,778	5,928,915	10,797,084	101,050,340	(f)	f 17,274,542	17,050,237	61,613,216	3,879,259	0	1,233,086	(f)	f
	Totals for section	45	1,586,787	132	735,686	8,092,971,297	6,831,721,444	1,261,249,853	48,627,793	154,216,838	946,613,756	1,918,070,194	5,025,442,716	20,000,940	1,027,258,430	729,269,152	2,996,231,288	139,640,405	95,525,079	17,517,422	22,066	1,
	Middle Atlantic States																					
16	Niagara Hudson Power Corporation (e)	7	614,000	95	997,342	8,056,607,028	6,714,747,766	1,341,859,262	2,248,191	65,741,822	815,788,085	1,154,644,900	6,018,184,030	41,176,273	504,338,186	624,863,108	4,636,477,666	83,499,696	93,352,367	34,476,734	40,318	
17	Consolidated Edison Co. of New York, Inc., & Assoc. Elec. Cos.	10	2,346,200	0	0	6,538,146,699	6,108,669,441	429,477,258	0	75,379,008	857,457,803	0	5,605,309,888	0	1,090,848,878	1,414,181,942	1,863,979,319	146,023,359	886,609,018	203,667,372	0	1,
18	Philadelphia Electric Company System	9	833,610	3	253,765	3,833,949,130	4,290,378,307	—456,429,177	0	k 13,171,744	405,015,246	203,849,107	r3,211,913,033	1,526,128	490,662,450	382,165,397	1,494,485,766	30,368,336	786,369,558	s 26,335,398	616	
19	Public Service Electric and Gas Company	5	684,450	0	0	2,747,123,450	2,154,433,978	592,689,472	k 90,930,101	25,410,769	362,827,838	2,351,760	2,265,602,982	(f)	f 489,534,186	f 569,159,504	1,108,555,353	61,961,339	36,392,600	0	(f)	f
20	American Water Works and Electric Co., Inc.	27	533,289	u 11	u 57,390	2,543,471,490	2,480,976,284	62,495,206	I 46,154,295	K 13,780,456	299,342,108	17,326,906	2,166,867,725	(f)	f 246,449,210	177,963,881	1,703,164,129	20,477,910	18,812,595	0	(f)	f
21	Pennsylvania Water & Power Co. and Safe Harbor W. P. Corp.	1	20,000	2	291,000	1,848,643,400	1,817,347,400	31,296,000	0	0	81,508,500	1,767,134,900	0	0	0	0	0	0	0	0	0	
22	Duquesne Light Company	u 4	444,000	0	0	1,836,112,375	1,844,030,670	—7,918,295	H 60,718	6,008,352	164,070,379	452,560	1,665,520,366	0	271,120,755	136,399,101	1,027,344,973	29,638,000	201,017,537	0	0	
23	Pennsylvania Power & Light Company (A)	16	347,512	20	44,677	1,778,250,081	1,454,585,385	323,664,696	0	4,199,861	197,433,479	15,683,324	1,560,933,417	24,330,014	191,709,666	163,447,232	1,079,053,128	21,887,702	41,095,929	39,409,746	22,740	
24	Metropolitan Edison Co. and N. J. Power & Light Co.	4	224,000	5	22,198	952,593,241	801,854,131	150,739,110	0	9,572,760	112,965,140	132,941,033	697,114,308	15,216,798	90,122,734	54,500,359	497,295,934	9,105,149	22,175,913	8,697,421	11,370	
25	New York State Electric & Gas Corp. and Affiliates (D)	7	81,130	25	22,315	819,824,422	434,436,471	385,387,951	4,238,651	5,749,718	118,057,401	92,369,344	599,409,308	24,022,485	145,642,245	83,064,335	298,132,621	21,335,534	984,961	26,227,127	24,476	
26	Pennsylvania Electric Company and Affiliates	7	98,675	2	48,000	475,273,697	466,270,745	9,002,952	0	4,475,501	81,293,515	25,753,189	363,751,492	6,061,421	59,576,703	40,986,646	242,781,899	4,206,521	1,796,310	8,341,992	7,749	
27	Rochester Gas & Electric Corp.	6	89,975	11	48,460	461,273,378	409,468,640	51,804,738	0	17,547,131	63,701,064	5,259,821	374,765,362	6,651,942	74,494,872	99,002,861	137,539,627	21,722,626	22,461,875	12,891,559	8,197	
28	Long Island Lighting System	6	166,500	0	0	339,368,889	339,353,499	15,390	0	7,792,684	68,920,311	3,584,578	259,071,316	0	106,571,194	56,916,213	60,185,827	21,352,730	14,041,750	k 3,602	0	
29	Jersey Central Power and Light Company	5	137,300	1	350	312,040,010	365,826,650	—53,786,640	0	6,744,489	50,819,971	6,070,193	248,405,357	(f)	f 63,424,522	f 28,379,386	119,278,959	8,456,141	12,946,450	15,919,899	(f)	f
30	Pennsylvania Edison Co., formerly Penn. Central L. & P. Co.	3	76,100	2	4,100	301,486,160	300,437,320	1,048,840	0	2,113,726	39,037,671	40,094,944	220,239,819	5,100,477	32,038,520	16,250,354	150,545,489	2,875,393	10,227,180	3,202,406	7,096	
31	The Scranton Electric Company	3 m	117,700	0	0	299,759,917	295,181,064	4,578,853	0	1,692,040	29,211,682	30,267,490	238,588,705	458,357	41,587,837	33,774,896	145,691,373	4,958,941	12,117,301	0	723	
32	Atlantic City Electric Company	2 m	120,000	0	0	296,238,004	295,689,504	548,500	0	3,145,543	38,595,573	3,392,800	251,104,088	6,706,452	52,448,666	64,724,384	117,749,591	8,857,295	617,700	0	5,799	
33	Pennsylvania Power Company	1	2,500	0	0	264,098,057	0	264,098,057	0	129,408	19,284,005	6,865,300	237,819,344	4,885,141	29,153,812	24,589,971	171,538,533	3,020,637	3,106,830	1,524,420	4,557	
34	Central Hudson Gas & Electric Corporation	1	12,000	6	23,740	244,548,853	111,232,500	133,316,353	0	7,721,776	34,344,667	35,370,085	167,112,325	9,340,907	44,291,672	38,472,052	68,197,219	6,810,475	0	0	5,807	
35	Luzerne County Gas and Electric Corporation	2	55,000	0	0	139,909,444	208,977,210	—69,067,766	0	1,492,960	13,247,202	902,269	124,267,013	631,188	16,101,550	12,485,668	84,228,269	2,540,487	8,028,027	251,824	1,231	
36	Staten Island Edison Corporation	1	47,500	0	0	130,148,280	127,054,880	3,093,400	0	1,897,995	16,936,860	3,119,200	108,194,225	127,527	29,321,861	15,843,108	32,880,651	6,972,341	15,651,550	7,397,187	103	
37	Rockland Light and Power Company and Subsidiaries	1	9,000	4	20,200	99,843,227	73,711,260	26,131,967	0	870,973	17,153,454	22,012,560	59,806,240	(f)	f 21,494,266	12,093,196	23,510,345	2,708,433	0	0	(f)	f
	Totals for section	128	7,060,441	187	1,833,537	34,318,709,232	31,094,663,105	3,224,046,127	143,631,956	274,638,716	3,887,011,954	3,569,446,263	26,443,980,343	146,235,110	4,090,933,785	4,049,263,594	15,062,616,671	518,779,045	2,187,805,451	388,346,687	140,782	5,
	East North Central States																					
38	Commonwealth Edison Group (D)	13	1,848,900	5	7,300	7,124,493,000	7,063,834,000	60,659,000	0	(p)	p 865,027,000	780,563,000	5,478,903,000	24,748,000	937,786,000	(d)	d3,259,444,000	254,366,000	1,002,559,000	0	22,653	1,
39	American Gas and Electric Co. (Interconnected System)	22 M	885,663	18	127,594	4,780,962,660	4,759,473,111	21,489,549	0	22,497,184	466,979,029	692,460,498	3,599,025,949	30,116,130	361,215,595	345,389,250	2,798,096,570	28,820,221	35,388,183	0	33,577	
40	The Detroit Edison Company	7	921,525	7	9,300	3,217,074,600	3,208,884,200	8,190,400	0	29,563,000	342,884,000	125,722,300	2,718,905,300	22,698,400	j 474,411,300	570,617,700	1,515,861,700	35,007,000	71,105,000	29,204,200	27,157	
41	The Cleveland Electric Illuminating Company	4	477,500	0	0	1,707,030,545	1,702,479,067	4,551,478	0	7,904,486	192,678,768	18,915,560	1,487,531,731	6,998,403	o 232,095,459	o 202,186,209	858,320,526	18,427,608	163,041,880	6,461,646	6,322	
42	Consumers Power Company	6	265,500	42 L	147,715	1,691,883,618	1,540,769,221	151,114,397	0	1,924,121	255,514,410	33,835,169	1,400,609,918	37,510,432	288,727,173	253,266,461	786,273,041	19,845,128	3,963,000	11,024,683	41,307	
43	Columbia Gas & Electric Corp. and Subsidiary Cos.	5	406,750	0	0	1,510,463,212	1,497,657,540	12,805,672	11,159,940	20,454,084	152,532,978	102,976,256	1,223,339,954	(f)	f 243,550,277	164,287,397	645,843,494	74,394,166	95,264,620	0	(f)	f
44	The Milwaukee Elec. R. & Light Co. & Affil. Cos. (D)	u 8 n	496,314	u 12	35,430	1,506,345,202	1,442,844,618	63,500,584	108,710,453	21,172,995	198,268,750	47,511,273	1,130,681,731	23,738,269	238,405,538	162,258,825	647,030,014	29,560,095	7,228,793	22,460,197	21,518	
45	Ohio Edison Company	5	311,500	1	1,950	1,280,942,731	1,233,435,985	47,506,746	0	4,599,340	118,544,573	333,530,147	824,268,671	10,350,000	160,817,165	155,826,028	451,525,495	13,710,597	30,907,408	s 1,131,978	11,500	
46	Northern Indiana Public Service Company	3	72,100	15	19,355	811,819,822	501,172,657	310,647,165	0	12,002,949	95,825,791	132,139,019	571,852,063	4,589,475	44,522,180	28,442,735	444,047,527	16,347,074	33,903,072	0	5,130	
47	Public Service Company of Indiana	6	132,230	2	4,290	774,930,789	617,860,541	157,070,248	0	5,676,695	110,723,555	243,651,685	414,878,854	8,003,427	62,885,369	52,779,834	201,125,601	9,330,541	69,028,309	11,725,773	9,461	
48	The Ohio Public Service Company	8	125,100	0	0	624,773,675	481,161,280	143,612,395	1,354,981	2,832,459	61,854,575	84,700,583	474,031,077	8,478,975	58,843,451	51,565,161	348,158,077	6,985,413	0	0	10,970	
49	The Toledo Edison Company	5	172,380	1	5,000	551,992,650	437,143,050	114,849,600	0	3,314,430	66,998,484	3,610,135	478,069,601	4,844,631	69,403,963	(d)	d 345,765,772	10,667,839	47,387,396	0	6,422	
50	Indianapolis Power & Light Company	4	165,200	0	0	472,851,586	470,256,566	2,595,020	0	6,846,373	48,635,217	12,547,790	404,822,206	15,475,325	70,361,867	88,627,626	211,619,856	18,737,532	0	0	14,544	
51	Central Illinois Public Service Company	2	75,000	0	0	459,166,919	224,216,736	234,950,183	0	17,904,921	77,867,821	59,545,992	303,848,185	6,123,165	65,044,584	44,406,534	168,565,094	9,249,785	0	10,459,033	5,250	
52	Columbus and Southern Ohio Electric Company	15	153,475	0	0	419,604,165	415,521,731	4,082,434	0	2,581,083	60,855,725	27,417,622	328,749,735	0	76,962,047	66,310,519	155,848,515	3,800,955	24,497,236	1,330,463	0	
53	Central Illinois Light Company	4	88,500	0	0	381,249,257	368,010,187	13,239,070	0	1,927,319	30,983,876	4,849,347	343,488,715	3,261,748	47,722,362	68,707,863	217,961,768	4,905,054	929,920	0	3,228	
54	Wisconsin Power and Light Company	6	50,604	31	35,661	326,457,386	304,856,602	21,600,784	1,645,850	6,895,055	55,185,128	98,540,987	164,190,366	11,076,794	51,831,201	33,006,074	61,595,602	6,680,695	0	0	14,114	
55	Wisconsin Public Service Corp. and Subsidiary	4	42,000	19	47,221	317,889,907	301,808,758	16,081,149	3,058,250	2,885,024	47,134,862	27,238,816	237,572,955	6,715,750	38,635,490	N 43,853,564	140,363,715	5,785,652	0	2,218,784	10,079	
56	Northern Indiana Power Company	6	23,000	1	384	227,974,369	1,816,565	226,157,804	0	764,355	47,441,477	22,741,241	157,027,296	3,518,774	23,552,944	18,882,970	101,610,778	3,053,074	858,300	5,550,456	4,365	
57	City of Detroit, Public Lighting Commission	1	80,000	0	0	219,995,160	200,307,000	19,688,160	0	o 95,769,219	13,797,572	0	110,428,369	0	0	(d)	d 13,638,229	0	96,790,140	0	0	
58	The Sanitary District of Chicago	0	0	1	35,000	212,568,167	134,570,360	77,997,807	0	687,146	10,411,732	0	201,469,289	0	0	0	2,253,489	115,501,139	0	o 83,714,661	0	
59	City of Cleveland, Dept. of Public Utilities	1	50,000	0	0	205,752,128	205,752,128	0	0	16,796,428	23,531,919	0	165,423,781	0	34,223,758	33,584,637	52,303,923	30,113,919	0	15,197,544	0	
60	Indiana Service Corporation	1	31,000	0	0	201,481,455	50,732,500	150,748,955	12,743,612	760,339	16,513,454	14,198,370	157,265,680	1,901,736	13,053,338	17,018,976	111,845,701	556,574	10,522,208	2,367,147	2,762	
61	Southern Indiana Gas and Electric Co.	3	50,900	0	0	143,260,330	143,260,330	0	4,732,587	755,529	17,893,727	258,820	119,619,667	977,471	20,627,871	30,332,975	62,784,877	2,813,960	2,082,513	0	1,367	
62	City of Lansing, Board of Water and Electric Light Comm'rs.	1	55,000	2	1,200	139,612,207	139,569,807	42,400	0	484,530	8,175,547	0	130,952,130	0	29,200,741	27,217,015	70,339,333	4,195,041	0	0	0	

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I—Detailed Data on Generator Rating, Output, Customers and Distribution of Energy
lic Utility Systems Having an Output Exceeding 100,000,000 Kw.-Hr. During 1937

This tabulation is based on the operating company as the unit. Group statistics are given in a few instances for properties which, though distinct corporate entities, are operated as a single physical system.

31, 1937	Source of Energy, 1937			Disposal of Energy					Distribution of Sales to Ultimate Consumers in Kilowatt-Hours							Number of Customers, Dec. 31, 1937						Line No.
o Plants Rating of Generators, Kw. (6)	Total Input (Net), Kw.-Hr. (7)	Generated (Net), Kw.-Hr. (8)	Received by Purchase or Interchange (Net), Kw.-Hr. (9)	Used by Elec. Ry. Dept., Kw.-Hr. (10)	Used by Elec. and Other Depts., Kw.-Hr. (11)	Lost and Unaccounted For, Kw.-Hr. (12)	To Other Public Utilities, Kw.-Hr. (13)	Sales to Ultimate Consumers, Kw.-Hr. (14)	Farm, or Farm and Rural (15)	Domestic Service (16)	Commercial Small Light and Power (Retail) (17)	Commercial Large Light and Power (Wholesale) (18)	Municipal Street Lighting, etc. (19)	Railways & Electrified Railroads (20)	Other Sales to Ultimate Consumers (21)	Farm or Rural (22)	Domestic (23)	Com'l Small Lt. and Power (24)	Com'l Large Lt. and Power (25)	Other Ult. Consumers (26)	Total (27)	(28)
327,680	2,373,707,292	2,015,180,468	358,526,824	29,843,754	57,452,898	315,078,643	601,927,210	1,369,404,787	(f)	f 256,400,998	150,162,568	904,101,575	41,508,880	17,230,766	0	(f)	f 435,605	61,785	9,700	286	507,376	1
300	1,274,632,523	1,092,537,385	182,095,138	0	13,924,497	171,785,974	238,199,639	850,722,413	5,006,467	225,363,931	201,791,389	367,273,372	35,019,544	16,267,710	0	a 2,487	a 337,143	a 72,206	a 742	a 108	a 412,686	2
66,815	748,186,164	609,043,693	139,142,471	0	7,582,452	93,910,314	118,631,430	528,061,968	(f)	f 127,742,071	50,667,373	316,283,050	10,577,100	22,792,374	0	(f)	f 140,944	17,769	2,077	1	160,791	3
107,350	536,254,451	515,342,221	20,912,230	H 4,690,840	44,339,375	70,014,557	48,419,765	368,789,914	6,978,176	38,432,638	24,729,298	283,555,537	4,469,374	4,291,889	6,333,002	10,097	60,179	10,766	1,994	1,320	84,356	4
99,750	494,773,000	o 386,983,000	o 107,790,000	0	5,827,000	67,907,000	94,231,000	326,808,000	(f)	f 60,070,000	45,832,000	195,431,000	8,862,000	15,135,000	l 1,478,000	(f)	f 78,776	13,364	2,007	44	94,191	5
1,500	424,015,650	397,563,850	26,451,800	0	5,969,072	26,914,592	146,774,041	244,357,945	(f)	f 73,386,388	71,205,072	76,216,448	7,933,637	15,616,400	0	(f)	a,f 62,733	a 9,898	a 98	a 27	a 72,756	6
0	372,354,300	372,354,300	0	0	1,317,388	37,821,679	12,224,000	320,991,233	(f)	f 69,596,760	66,676,935	177,019,036	7,698,502	0	0	(f)	f 111,736	15,708	3,538	15	130,997	7
0	368,319,073	351,444,930	16,874,143	0	0	0	368,319,073	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
10,760	312,501,944	159,647,970	152,853,974	0	3,365,215	26,898,885	143,317,599	138,920,245	(f)	f 46,282,874	19,762,675	69,019,799	3,854,897	0	0	(f)	a,f 46,918	a 7,204	a 1,834	a 0	a 55,956	9
63,474	278,350,995	269,304,764	9,046,231	435,297	5,111,092	36,671,286	81,404,381	154,728,939	5,912,839	30,703,515	18,778,170	88,747,915	4,974,384	3,426,740	2,185,376	7,311	50,082	8,486	1,883	789	68,551	10
0	226,962,770	226,962,770	0	0	2,321,483	18,538,223	32,667,400	173,435,664	731,022	16,736,471	10,783,309	141,202,672	2,940,265	0	1,041,925	488	37,324	4,642	784	272	43,510	11
1,850	214,398,897	35,348,372	179,050,525	0	1,423,678	25,126,927	5,169,412	182,678,880	(f)	f 21,624,106	16,526,765	137,616,795	2,993,973	0	3,917,241	(f)	f 44,076	5,410	447	217	50,150	12
25,172	213,038,940	171,777,540	41,261,400	10,987,262	3,270,750	28,097,557	14,039,700	156,643,671	1,372,436	27,224,736	22,914,770	99,588,238	3,713,099	764,200	1,066,192	1,683	41,884	6,700	1,911	462	52,640	13
31,035	136,455,181	136,390,381	64,800	2,670,640	1,068,160	21,919,204	1,948,460	108,848,717	(f)	f 16,419,400	12,388,591	78,562,635	1,215,491	0	l 262,600	0	24,431	5,260	943	66	30,700	14
0	119,020,117	91,839,800	27,180,317	0	1,243,778	5,928,915	10,797,084	101,050,340	(f)	f 17,274,542	17,050,237	61,613,216	3,879,259	0	1,233,086	(f)	f 28,960	4,502	927	133	34,522	15
735,686	8,092,971,297	6,831,721,444	1,261,249,853	48,627,793	154,216,838	946,613,756	1,918,070,194	5,025,442,716	20,000,940	1,027,258,430	729,269,152	2,996,231,288	139,640,405	95,525,079	17,517,422	22,066	1,500,791	243,700	28,885	3,740	1,799,182	
997,342	8,056,607,028	6,714,747,766	1,341,859,262	2,248,191	65,741,822	815,788,085	1,154,644,900	6,018,184,030	41,176,273	504,338,186	624,863,108	4,636,477,666	83,499,696	93,352,367	34,476,734	40,318	572,533	86,558	2,562	847	702,818	16
0	6,538,146,699	6,108,669,441	429,477,258	0	75,379,008	857,457,803	0	5,605,309,888	0	1,090,848,878	1,414,181,942	1,863,979,319	146,023,359	886,609,018	203,667,372	0	1,951,762	396,522	25,524	3,748	2,377,556	17
253,765	3,833,949,130	4,290,378,307	—456,429,177	0	k 13,171,744	405,015,246	203,849,107	z3,211,913,033	1,526,128	490,662,450	382,165,397	1,494,485,766	30,368,336	786,369,558	s 26,335,398	616	583,376	117,280	2,274	603	704,149	18
0	2,747,123,450	2,154,433,978	592,689,472	k 90,930,101	25,410,769	362,827,838	2,351,760	2,265,602,982	(f)	f 489,534,186	f 569,159,504	1,108,555,353	61,961,339	36,392,600	0	(f)	f 775,381	f 158,350	1,039	228	934,998	19
57,390	2,543,471,490	2,480,976,284	62,495,206	l 46,154,295	K 13,780,456	299,342,108	17,326,906	2,166,867,725	(f)	f 246,449,210	177,963,881	1,703,164,129	20,477,910	18,812,595	0	(f)	f 315,371	45,373	3,972	412	365,128	20
291,000	1,848,643,400	1,817,347,400	31,296,000	0	0	81,508,500	1,767,134,900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
0	1,836,112,375	1,844,030,670	—7,918,295	60,718	6,008,352	164,070,379	452,560	1,665,520,366	0	271,120,755	136,399,101	1,027,344,973	29,638,000	201,017,537	0	0	300,033	32,886	2,702	112	335,733	22
44,677	1,778,250,081	1,454,585,385	323,664,696	0	4,199,861	197,433,479	15,683,324	1,560,933,417	24,330,014	191,709,666	163,447,232	1,079,053,128	21,887,702	41,095,929	39,409,746	22,740	307,232	53,453	4,211	3,240	390,876	23
22,198	952,593,241	801,854,131	150,739,110	0	9,572,760	112,965,140	132,941,033	697,114,308	15,216,798	90,122,734	54,500,359	497,295,934	9,105,149	22,175,913	8,697,421	11,370	130,696	19,829	3,040	1,327	166,262	24
22,315	819,824,422	434,436,471	385,387,951	4,238,651	5,749,718	118,057,401	92,369,344	599,409,308	24,022,485	145,642,245	83,064,335	298,132,621	21,335,534	984,961	26,227,127	24,476	191,776	27,825	3,671	3,663	251,411	25
48,000	475,273,697	466,270,745	9,002,952	0	4,475,501	81,293,515	25,753,189	363,751,492	6,061,421	59,576,703	40,986,646	242,781,899	4,206,521	1,796,310	8,341,992	7,749	99,964	13,837	2,312	1,174	125,036	26
48,460	461,273,378	409,468,640	51,804,738	0	17,547,131	63,701,064	5,259,821	374,765,362	6,651,942	74,494,872	99,002,861	137,539,627	21,722,626	22,461,875	12,891,559	8,197	109,875	13,020	826	1,093	133,011	27
0	339,368,889	339,353,499	15,390	0	7,792,684	68,920,311	3,584,578	259,071,316	0	106,571,194	56,916,213	60,185,827	21,352,730	14,041,750	k 3,602	0	137,448	19,626	4,599	96	161,769	28
350	312,040,010	365,826,650	—53,786,640	0	6,744,489	50,819,971	6,070,193	248,405,357	(f)	f 63,424,522	f 28,379,386	119,278,959	8,456,141	12,946,450	15,919,899	(f)	f 83,052	f 12,051	832	1,070	97,005	29
4,100	301,486,160	300,437,320	1,048,840	0	2,113,726	39,037,671	40,094,944	220,239,819	5,100,477	32,038,520	16,250,354	150,545,489	2,875,393	10,227,180	3,202,406	7,096	48,009	6,088	1,908	596	63,697	30
0	299,759,917	295,181,064	4,578,853	0	1,692,040	29,211,682	30,267,490	238,588,705	458,357	41,587,837	33,774,896	145,691,373	4,958,941	12,117,301	0	723	69,850	10,539	225	36	81,373	31
0	296,238,004	295,689,504	548,500	0	3,145,543	38,595,573	3,392,800	251,104,088	6,706,452	52,448,666	64,724,384	117,749,591	8,857,295	617,700	0	5,799	70,881	15,232	80	124	92,116	32
0	264,098,057	0	264,098,057	0	129,408	19,284,005	6,865,300	237,819,344	4,885,141	29,153,812	24,589,971	171,538,533	3,020,637	3,106,830	1,524,420	4,557	36,294	5,305	75	184	46,415	33
23,740	244,548,853	111,232,500	133,316,353	0	7,721,776	34,344,667	35,370,085	167,112,325	9,340,907	44,291,672	38,472,052	68,197,219	6,810,475	0	0	5,807	55,835	11,993	119	80	73,834	34
0	139,909,444	208,977,210	—69,067,766	0	1,492,960	13,247,202	902,269	124,267,013	631,188	16,101,550	12,485,668	84,228,269	2,540,487	8,028,027	251,824	1,231	31,533	3,511	126	36	36,437	35
0	130,148,280	127,054,880	3,093,400	0	1,897,995	16,936,860	3,119,200	108,194,225	127,527	29,321,861	15,843,108	32,880,651	6,972,341	15,651,550	7,397,187	103	40,323	6,171	126	379	47,102	36
20,200	99,843,227	73,711,260	26,131,967	0	870,973	17,153,454	22,012,560	59,806,240	(f)	f 21,494,266	12,093,196	23,510,345	2,708,433	0	0	(f)	f 33,663	5,197	576	60	39,496	37
1,833,537	34,318,709,232	31,094,663,105	3,224,046,127	143,631,956	274,638,716	3,887,011,954	3,569,446,263	26,443,980,343	146,235,110	4,090,933,785	4,049,263,594	15,062,616,671	518,779,045	2,187,805,451	388,346,687	140,782	5,944,887	1,060,646	60,799	19,108	7,226,222	
7,300	7,124,493,000	7,063,834,000	60,659,000	0	(e)	o 865,027,000	780,563,000	5,478,903,000	24,748,000	937,786,000	(d)	d3,259,444,000	254,366,000	1,002,559,000	0	22,653	1,162,086	(d)	d 167,878	757	1,353,374	38
127,594	4,780,962,660	4,759,473,111	21,489,549	0	22,497,184	466,979,029	692,460,498	3,599,025,949	30,116,130	361,215,595	345,389,250	2,798,096,570	28,820,221	35,388,183	0	33,577	468,900	80,224	1,773	437	584,911	39
9,300	3,217,074,600	3,208,884,200	8,190,400	0	29,563,000	342,884,000	125,722,300	2,718,905,300	22,698,400	j 474,411,300	570,617,700	1,515,861,700	35,007,000	71,105,000	29,204,200	27,157	532,247	77,126	481	359	637,370	40
0	1,707,030,545	1,702,479,067	4,551,478	0	7,904,486	192,678,768	18,915,560	1,487,531,731	6,998,403	o 232,095,459	o 202,186,209	858,320,526	18,427,608	163,041,880	6,461,646	6,322	273,238	41,979	598	492	322,629	41
147,715	1,691,883,618	1,540,769,221	151,114,397	0	1,924,121	255,514,410	33,835,169	1,400,609,918	37,510,432	288,727,173	253,266,461	786,273,041	19,845,128	3,963,000	11,024,683	41,307	293,630	56,856	707	348	392,848	42
0	1,510,463,212	1,497,657,540	12,805,672	11,159,940	20,454,084	152,532,978	102,976,256	1,223,339,954	(f)	f 243,550,277	164,287,397	645,843,494	74,394,166	95,264,620	0	(f)	f 303,346	40,156	5,965	2,043	351,510	43
35,430	1,506,345,202	1,442,844,618	63,500,584	108,710,453	21,172,995	198,268,750	47,511,273	1,130,681,731	23,738,269	238,405,538	162,258,825	647,030,014	29,560,095	7,228,793	22,460,197	21,518	275,231	42,748	648	1,361	341,506	44
1,950	1,280,942,731	1,233,435,985	47,506,746	0	4,599,340	118,544,573	333,530,147	824,268,671	10,350,000	160,817,165	155,826,028	451,525,495	13,710,597	30,907,408	s 1,131,978	11,500	160,264	19,787	265	80	191,896	45
19,355	811,819,822	501,172,657	310,647,165	0	12,002,949	95,825,791	132,139,019	571,852,063	4,589,475	44,522,180	28,442,735	444,047,527	16,347,074	33,903,072	0	5,130	67,501	11,268	2,006	1,046	86,951	46
4,290	774,930,789	617,860,541	157,070,248	0	5,676,695	110,723,555	243,651,685	414,878,854	8,003,427	62,885,369	52,779,834	201,125,601	9,330,541	69,028,309	11,725,773	9,461	103,524	19,415	2,446	1,791	136,637	47
0	624,773,675	481,161,280	143,612,395	1,354,981	2,832,459	61,854,575	84,700,583	474,031,077	8,478,975	58,843,451	51,565,161	348,158,077	6,985,413	0	0	10,970	72,939	11,871	306	40	96,126	48
5,000	551,992,650	437,143,050	114,849,600	0	3,314,430	66,998,484	3,610,135	478,069,601	4,844,631	69,403,963	(d)	d 345,765,772	10,667,839	47,387,396	0	6,422	90,707	d 13,961	(d)	44	111,134	49
0	472,851,586	470,256,566	2,595,020	0	6,846,373	48,635,217	12,547,790	404,822,206	15,475,325	70,361,867	88,627,626	211,619,856	18,737,532	0	0	14,544	94,036	12,280	292	9	121,141	50
0	459,166,919	224,216,736	234,950,183	0	17,904,921	77,867,821	59,545,992	303,848,185	6,123,165	65,044,584	44,406,534	168,565,094	9,249,785	0	10,459,033	5,250	120,521	24,794	4,905	505	155,975	51
0	419,604,165	415,521,731	4,082,434	0	2,581,083	60,855,725	27,417,622	328,749,735	0	76,962,047	66,310,519	155,848,515	3,800,955	24,497,236	1,330,463	0	117,503	16,290	1,819	1	135,613	52
0	381,249,257	368,010,187	13,239,070	0	1,927,319	30,983,876	4,849,347	343,488,715	3,261,748	47,722,362	68,707,863	217,961,768	4,905,054	929,920	0	3,228	53,110	8,949	158	35	65,480	53
35,661	326,457,386	304,856,602	21,600,784	1,645,850	6,895,055	55,185,128	98,540,987	164,190,366	11,076,794	51,831,201	33,006,074	61,595,602	6,680,695	0	0	14,114	75,009	13,560	3,214	230	106,127	54
47,221	317,889,907	301,808,758	16,081,149	3,058,250	2,885,024	47,134,862	27,238,816	237,572,955	6,715,750	38,635,490	N 43,853,564	140,363,715	5,785,652	0	2,218,784	10,079	57,595	N 13,996	386	166	82,222	55
384	227,974,369	1,816,565	226,157,804	0	764,355	47,441,477	22,741,241	157,027,296	3,518,774	23,552,944	18,882,970	101,610,778	3,053,074	858,300	5,550,456	4,365	43,390	8,345	1,099	797	57,996	56
0	219,995,160	200,307,000	19,688,160	0	o 95,769,219	13,797,572	0	110,428,369	0	0	(d)	d 13,638,229	0	96,790,140	0	0	0	(d)	d 22	1	23	57
35,000	212,568,167	134,570,360	77,997,807	0	687,146	10,411,732	0	201,469,289	0	0	0	2,253,489	115,501,139	0	o 83,714,661	0	0	9	5	14	58
0	205,752,128	205,752,128	0	0	16,796,428	23,531,919	0	165,423,781	0	34,223,758	33,584,637	52,303,923	30,113,919	0	15,197,544	0	44,784	8,364	195	1	53,344	59
0	201,481,455	50,732,500	150,748,955	12,743,612	760,339	16,513,454	14,198,370	157,265,680	1,901,736	· 13,053,338	17,018,976	111,845,701	556,574	10,522,208	2,367,147	2,762	17,445	2,933	885	221	24,246	60
0	143,260,330	143,260,330	0	4,732,587	755,529	17,893,727	258,820	119,619,667	977,471	20,627,871	30,332,975	62,784,877	2,813,960	2,082,513	0	1,367	28,545	5,372	68	11	35,363	61
1,200	139,612,207	139,569,807	42,400	0	484,530	8,175,547	0	130,952,130	0	29,200,741	27,217,015	70,339,333	4,195,041	0	0	0	24,128	3,201	59	2	27,390	62

NOTES

(1) This table is designed to cover the demand and energy load due to both primary and secondary uses.

(2) In a number of instances reports indicated that the allocation of energy and customers was estimated. To avoid additional notes estimated quantites have not been specially marked.

(3) Where companies do not classify sales under the exact heads used in this table, items reported were entered under the most nearly appropriate caption. For instance, it was impracticable to distinguish between residential, urban, domestic.

(4) Preliminary returns, subject to revision, have been so marked.

a Lines 2, 6 — Bills rendered in Dec. 9, 65 — meters. 70 — Aver. bills during year. 78 — Active customers.

b Line 92 — Includes interchange. 124 — Interchange.

c Commercial light, or light and power, combined with domestic service.

d Retail combined with wholesale.

e Canadian Niagara Power Co., Ltd. (see Canada), included in Niagara Hudson Power Corp. System.

f Farm or rural combined with other.

g Output Duke Power Co., Hydro-E. P. Com. of Ontario, Canadian Niag. P. Co. not included in allocation because of lack of data.

h Transferred to affiliated transportation co.

i Eliminates energy representing revenues of L. A. G. & E. Corp. billed to consumers by Bureau and paid to Corp.

j Includes: 40 — water heater service (off peak); 151 — 937, 932, 139 off peak.

51	Central Illinois Public Service Company	2	75,000	0	0	459,166,919	224,216,736	234,950,183	0	17,904,921	77,867,821	59,545,992	303,848,185	6,123,165	65,044,584	44,406,534	168,565,094	9,249,785	0	10,459,033	5,250	
52	Columbus and Southern Ohio Electric Company	15	153,475	0	0	419,604,165	415,521,731	4,082,434	0	2,581,083	60,855,725	27,417,622	328,749,735	0	76,962,047	66,310,519	155,848,515	3,800,955	24,497,236	1,330,463	0	
53	Central Illinois Light Company	4	88,500	0	0	381,249,257	368,010,187	13,239,070	0	1,927,319	30,983,876	4,849,347	343,488,715	3,261,748	47,722,362	68,707,863	217,961,768	4,905,054	929,920	0	3,228	
54	Wisconsin Power and Light Company	6	50,604	31	35,661	326,457,386	304,856,602	21,600,784	1,645,850	6,895,055	55,185,128	98,540,987	164,190,366	11,076,794	51,831,201	33,006,074	61,595,602	6,680,695	0	0	14,114	
55	Wisconsin Public Service Corp. and Subsidiary	4	42,000	19	47,221	317,889,907	301,808,758	16,081,149	3,058,250	2,885,024	47,134,862	27,238,816	237,572,955	6,715,750	38,635,490	N 43,853,564	140,363,715	5,785,652	0	2,218,784	10,079	
56	Northern Indiana Power Company	6	23,000	1	384	227,974,369	1,816,565	226,157,804	0	764,355	47,441,477	22,741,241	157,027,296	3,518,774	23,552,944	18,882,970	101,610,778	3,053,074	858,300	5,550,456	4,365	
57	City of Detroit, Public Lighting Commission	1	80,000	0	0	219,995,160	200,307,000	19,688,160	0	o 95,769,219	13,797,572	0	110,428,369	0	0	(d)	d 13,638,229	0	96,790,140	0	0	
58	The Sanitary District of Chicago	0	0	1	35,000	212,568,167	134,570,360	77,997,807	0	687,146	10,411,732	0	201,469,289	0	0	0	2,253,489	115,501,139	0	o 83,714,661	0	
59	City of Cleveland, Dept. of Public Utilities	1	50,000	0	0	205,752,128	205,752,128	0	0	16,796,428	23,531,919	0	165,423,781	0	34,223,758	33,584,637	52,303,923	30,113,919	0	15,197,544	0	
60	Indiana Service Corporation	1	31,000	0	0	201,481,455	50,732,500	150,748,955	12,743,612	760,339	16,513,454	14,198,370	157,265,680	1,901,736	13,053,338	17,018,976	111,845,701	556,574	10,522,208	2,367,147	2,762	
61	Southern Indiana Gas and Electric Co.	3	50,900	0	0	143,260,330	143,260,330	0	4,732,587	755,529	17,893,727	258,820	119,619,667	977,471	20,627,871	30,332,975	62,784,877	2,813,960	2,082,513	0	1,367	
62	City of Lansing, Board of Water and Electric Light Comm'rs	1	55,000	2	1,200	139,612,207	139,569,807	42,400	0	484,530	8,175,547	0	130,952,130	0	29,200,741	27,217,015	70,339,333	4,195,041	0	0	0	
63	Central Illinois Electric and Gas Co.	4	46,238	1	1,200	128,607,050	50,747,600	77,859,450	958,310	5,409,964	14,116,564	0	108,122,212	1,123,040	24,458,042	20,480,724	55,292,708	3,481,370	0	3,286,328	1,178	
64	The Marion-Reserve Power Company and Ohio Elec. P. Co.	1	24,500	0	0	115,412,991	59,374,500	56,038,491	0	4,212,575	13,148,349	12,056,498	85,995,569	6,096,213	13,972,706	11,377,571	49,596,033	2,400,955	0	2,552,091	10,351	
65	Lake Superior District Power Co.	3	16,490	8	13,848	102,676,535	98,532,855	4,143,680	0	455,360	16,260,198	1,637,023	84,323,954	709,618	12,179,518	11,137,040	58,629,720	1,668,058	0	0	a 1,325	a
	Totals for section	148	7,067,369	166	492,448	29,657,272,116	27,656,049,495	2,001,222,621	144,363,983	297,076,963	3,429,785,081	2,880,648,131	22,905,397,958	239,055,776	3,694,489,939	2,501,563,688	13,835,741,158	730,405,445	1,695,456,978	208,684,984	264,580	4,
	West North Central States																					
66	Union Electric Company of Missouri and Subsidiaries	6	414,670	2	237,000	2,399,584,146	2,399,550,471	33,675	1,414,086	9,296,664	314,064,537	398,701,968	1,676,106,891	0	279,243,210	310,355,113	901,438,962	34,323,931	138,923,160	11,822,515	0	
67	Northern States Power Co. (Delaware) and Subsidiary Cos.	19	291,276	25	128,875	1,319,245,332	1,265,021,716	54,223,616	672,234	12,508,587	208,082,493	66,371,824	1,031,610,194	6,087,203	286,277,499	238,893,581	470,186,967	29,556,644	608,300	0	5,994	
68	Kansas City Power & Light Company	22	263,211	0	0	757,407,101	754,125,227	3,281,874	0	7,960,379	68,475,495	68,840,202	612,131,025	3,520,265	108,141,793	75,389,717	315,978,387	14,975,447	93,615,915	509,501	3,661	
69	Minnesota Power & Light Co. (*A*)	5	30,420	11	94,911	460,170,563	458,791,183	1,379,380	0	1,989,427	69,328,958	51,872,258	336,979,920	1,232,083	31,431,764	37,527,691	250,822,941	2,795,369	13,170,072	0	1,943	
70	Nebraska Power Co. (*A*)	T 1	T 106,500	0	0	397,621,500	397,621,500	0	0	1,561,600	36,715,700	23,784,200	335,560,000	5,759,600	61,583,300	(d)	d 211,043,400	8,333,600	30,023,800	18,816,300	a 3,630	a
71	Kansas Gas & Electric Co. (*A*)	2	66,000	0	0	319,946,200	319,881,300	64,900	0	1,821,953	44,349,993	17,961,191	255,813,063	3,213,198	42,992,707	46,723,515	153,130,160	2,763,322	1,102,747	5,887,414	3,233	
72	The Empire District Electric Co.	1	66,500	4	T 76,920	310,101,736	307,744,710	2,357,026	0	996,260	54,484,052	80,615,820	174,005,604	1,489,347	10,981,573	14,551,575	142,944,495	1,959,614	2,079,000	0	2,044	
73	Des Moines Electric Light Company	2	73,800	1	500	244,104,646	244,104,646	0	0	1,121,079	34,850,907	41,112,611	167,020,049	2,109,455	37,803,402	24,605,068	92,912,605	5,604,706	0	3,984,813	2,112	
74	Sioux City Gas & Elec. Co.—Iowa Pub. Service Co. (System)	19	76,065	4	2,051	214,235,832	206,863,342	7,372,490	0	4,163,514	35,065,971	15,187,797	159,818,550	3,678,038	39,414,623	d 96,566,460	(d)	6,197,543	5,134,658	8,827,228	5,290	
75	Interstate Power Company (Del.) and Subs.	T 16	T 64,673	T 13	T 7,145	184,787,010	153,368,360	31,418,650	0	1,375,975	34,130,430	20,523,826	128,756,779	4,089,016	37,209,714	42,975,498	32,663,463	5,453,961	0	6,365,127	4,181	
76	Iowa Electric Light and Power Company	8	61,653	2	1,460	178,821,678	177,667,228	1,154,450	3,425,129	2,253,325	20,249,386	26,155,710	126,738,128	3,394,865	27,476,120	21,488,400	69,062,129	2,555,514	2,761,100	0	3,677	
77	Iowa-Nebraska Light and Power Company	39	43,115	17	2,235	144,924,342	112,086,367	32,837,975	0	2,737,863	20,327,569	13,466,273	108,392,637	1,775,560	32,454,704	31,451,228	35,031,051	2,711,125	1,019,692	3,949,277	2,514	
78	Kansas City, Kan., Board of Public Utilities	1	39,000	0	0	144,707,638	144,707,638	0	0	o 14,355,609	14,597,760	0	115,754,269	0	24,721,092	18,907,087	68,085,878	3,052,792	987,420	0	0	a
79	Laclede Power & Light Company	2	33,500	0	0	140,281,685	100,851,465	39,430,220	0	46,634	17,188,891	0	123,046,160	0	23,781,524	19,330,946	80,037,891	0	0	s —104,201	0	
80	Iowa Southern Utilities Company	6	25,107	0	0	118,063,646	47,960,598	70,103,048	446,500	0	21,026,440	6,551,018	90,039,688	1,271,982	22,865,014	23,618,027	39,763,073	2,521,592	0	0	1,998	
	Totals for sections	149	1,655,490	79	551,097	7,334,003,055	7,090,345,751	243,657,304	5,957,949	62,188,869	992,938,582	831,144,698	5,441,772,957	37,620,612	1,066,378,039	1,002,383,906	2,863,101,402	122,805,160	289,425,864	60,057,974	40,277	1,
	South Atlantic States																					
81	Duke Power Co.					g2,385,188,583																
82	Georgia Power Co.	20	94,749	23	289,875	1,870,625,418	1,502,636,635	367,988,783	52,203,836	12,423,142	x 313,355,743	x 132,680,103	1,359,962,594	14,323,400	185,961,343	225,285,491	915,275,264	17,916,939	1,200,157	0	11,018	
83	Consolidated Gas Electric Light & Power Co. of Baltimore	3	230,950	0	0	1,508,885,800	287,060,000	x1,221,825,800	0	19,315,590	x 137,499,411	x 16,228,690	1,335,842,109	0	217,577,670	175,603,707	670,114,069	F 14,228,063	258,318,600	0	0	
84	Carolina Power & Light Co. (*A*)	2	43,000	10	206,050	1,035,987,080	817,718,335	218,268,745	0	2,197,412	172,134,448	284,455,601	577,199,619	6,102,826	73,994,803	58,236,218	414,746,306	5,213,955	0	18,905,511	7,759	
85	Potomac Electric Power Company & Small Affiliate	2	220,000	0	0	835,167,909	681,860,909	153,307,000	0	5,015,649	109,975,934	1,195,400	718,980,926	4,956,492	171,141,725	198,536,254	235,606,896	25,502,893	83,236,666	0	928	
86	Virginia Electric and Power Company	3	142,500	7	30,535	664,859,694	617,299,254	47,560,440	31,253,514	6,788,426	77,300,326	23,426,724	526,090,704	5,809,025	122,206,147	136,033,780	249,275,395	3,627,046	1,220,400	7,918,911	3,442	
87	South Carolina Elec. & Gas Corp. and Lexington Wtr. Pwr. Co.	1	72,500	3	154,600	484,268,621	472,859,009	11,409,612	0	5,203,575	34,292,323	306,950,994	137,821,729	1,794,759	12,257,360	11,991,145	108,666,058	1,333,270	0	1,779,137	1,672	
88	Florida Power & Light Co. (*A*)	38	139,033	0	0	341,281,000	339,664,000	1,617,000	0	12,979,000	71,892,000	139,000	256,271,000	5,966,000	99,267,000	88,372,000	35,740,000	23,305,000	3,621,000	0	910	
89	Virginia Public Service Company	9	83,582	10	15,106	294,870,805	279,242,008	15,628,797	5,156,460	6,306,890	49,627,695	8,895,971	224,883,789	6,615,289	60,712,917	32,260,690	114,626,269	4,231,402	279,700	6,157,522	5,081	
90	Delaware Power & Light Company	1	T 22,500	0	0	203,499,471	624,800	202,874,671	0	1,079,535	12,241,151	10,253,238	179,925,547	0	27,516,862	y 35,793,690	z 102,201,602	2,531,659	11,473,464	408,270	0	
91	Florida Power Corporation	6	44,734	3	14,193	180,210,532	147,047,532	33,163,000	0	1,261,998	31,722,091	85,859,400	61,367,043	1,392,159	22,386,187	17,146,207	18,349,266	839,003	0	1,254,221	1,183	
92	Tampa Electric Company	2	42,500	0	0	176,836,617	155,497,400	21,339,217	8,267,803	3,064,761	20,337,818	b 14,691,348	130,474,887	1,583,930	20,910,582	20,311,055	83,381,271	2,337,389	0	1,950,660	1,402	
93	South Carolina Power Company	6	20,132	1	21,600	163,881,369	155,917,266	7,964,103	1,104,592	917,198	22,304,906	28,229,308	111,325,365	1,093,652	23,028,827	19,462,416	65,733,826	2,006,644	0	0	745	
94	Jacksonville Municipal Light Plant	1	54,500	0	0	134,730,300	134,730,300	0	0	0	15,644,686	11,865,957	107,219,657	0	32,876,223	30,759,097	35,199,055	4,884,898	0	3,500,384	0	
	Totals for section	94	1,210,680	57	731,959	g7,895,104,616	5,592,157,448	2,302,947,168	97,986,205	76,553,176	1,068,328,532	924,871,734	5,727,364,969	49,637,532	1,069,837,646	1,049,791,750	3,048,915,277	107,958,161	359,349,987	41,874,616	34,140	1
	East South Central States																					
95	Alabama Power Company	12	165,244	6	414,500	2,347,860,603	2,321,073,544	26,787,059	937,400	5,106,750	306,702,995	864,994,521	1,170,118,937	16,947,620	106,699,739	102,495,898	936,656,425	7,319,255	0	0	16,782	
96	The Tennessee Electric Power Company	14	107,267	13	139,742	1,016,040,717	927,935,507	88,105,210	25,925,264	7,462,891	200,519,924	23,130,806	759,001,832	12,307,000	142,111,346	110,033,478	489,253,031	3,787,337	467,900	1,041,740	9,100	
97	Tennessee Valley Authority	3	65,300	3	348,000	494,798,710	494,798,710	0	0	145,294,393	51,352,246	100,838,625	197,313,446	1,187,004	804,035	1,010,162	194,304,629	7,616	0	0	1,285	
98	Louisville Gas and Electric Co. (Kentucky)	2	111,000	1	80,320	434,964,424	416,834,920	18,129,504	0	5,121,715	41,818,968	73,597,101	314,426,640	0	60,004,398	48,429,478	144,105,920	8,130,750	33,871,136	19,884,958	0	
99	Kentucky Utilities Company	8	48,450	2	24,500	360,060,994	291,978,145	68,082,849	0	6,015,711	46,812,726	112,615,756	194,616,801	2,830,995	29,675,634	30,242,931	121,643,990	3,728,137	0	6,495,114	2,956	
100	Birmingham Electric Co. (*A*)	1	11,300	0	0	304,739,650	0	304,739,650	34,033,014	1,850,958	35,208,256	0	233,647,422	0	44,661,518	129,862,224	54,910,107	2,936,803	0	1,276,770	0	
101	Memphis Power & Light Co. (*A*)	1	54,000	0	0	264,038,000	256,503,000	O 7,535,000	0	1,655,000	34,047,000	25,444,000	202,892,000	1,010,000	35,527,000	32,585,000	96,950,000	4,169,000	27,187,000	5,464,000	1,162	
102	Mississippi Power & Light Co. (*A*)	28	15,968	0	0	219,639,269	20,235,000	199,404,269	0	976,000	40,950,269	261,000	177,452,000	4,824,000	25,559,000	30,276,000	96,022,000	18,782,000	0	t 1,989,000	1,728	
103	Mississippi Power Company	14	18,702	0	0	174,343,758	23,990,511	150,353,247	0	1,030,776	29,005,228	2,199,520	142,108,234	593,639	24,776,333	26,260,984	77,779,377	2,619,818	45,600	10,032,483	515	
104	Tennessee Public Service Co. (*A*)	1	3,125	1	150	157,815,530	495,570	157,319,960	5,699,463	2,723,083	14,429,909	1,964,599	132,998,476	1,699,463	25,464,077	25,325,116	74,753,661	2,070,198	0	3,685,961	1,513	
	Totals for section	84	600,356	26	1,007,212	5,774,301,655	4,753,844,907	1,020,456,748	66,595,141	177,237,277	800,847,521	1,205,045,928	3,524,575,788	41,399,721	495,283,080	536,521,271	2,286,379,140	53,550,914	61,571,636	49,870,026	35,041	
	West South Central States																					
105	Louisiana Power & Light Co. (*A*)	11	86,874	0	0	760,703,000	629,785,000	130,918,000	0	2,689,000	43,622,000	442,972,000	271,420,000	3,097,000	15,296,000	y 13,008,000	z 233,993,000	6,026,000	0	0	3,034	
106	Oklahoma Gas and Electric Company	14	173,676	0	0	691,820,908	670,608,024	21,212,884	0	4,985,472	107,699,325	7,848,098	571,288,013	13,452,485	78,737,582	84,219,637	z 349,039,431	8,320,263	14,281,200	23,237,415	7,074	
107	Houston Light & Power Co. (*A*)	4	181,586	0	0	659,912,000	643,144,000	16,768,000	0	2,708,673	76,047,258	17,886,766	563,269,303	6,017,887	81,485,372	134,054,197	287,381,483	4,550,081	17,066,198	32,714,085	688	
108	Texas Power & Light Co. (*A*)	12	97,731	4	885	588,397,000	554,907,000	33,490,000	0	(v)	v 121,526,000	73,404,000	393,467,000	6,295,000	59,891,000	62,344,000	214,702,000	32,696,000	17,539,000	0	10,396	
109	Texas Electric Service Co. (*A*)	11	98,078	0	0	477,809,000	463,306,000	14,503,000	0	0	83,735,000	37,767,000	356,307,000	1,708,000	49,824,000	71,325,000	201,617,000	25,579,000	6,254,000	0	1,834	
110	Arkansas Power & Light Co. (*A*)	19	42,848	3	65,666	452,466,000	205,340,000	247,126,000	0	7,905,000	77,776,000	65,249,000	301,536,000	2,203,000	34,857,000	42,396,000	208,357,000	13,723,000	0	0	2,629	
111	New Orleans Public Service, Inc. (*A*)	1	108,000	0	0	444,434,000	444,434,000	0	35,137,000	4,045,411	39,325,142	114,858,796	251,067,651	0	46,319,846	84,353,096	94,552,795	25,841,914	0	0	0	
112	Gulf States Utilities Company	10	75,596	0	0	367,401,350	250,131,115	117,270,235	H 59,200	7,880,108	54,783,953	26,206,669	278,471,420	242,645	42,955,740	36,673,905	190,945,929	1,354,011	1,239,770	5,059,420	44	
113	Dallas Power & Light Co. (*A*)	1	82,500	0	0	308,008,316	308,267,700	—259,384	0	3,400,283	31,855,286	0	272,752,747	248,490	58,381,694	114,718,001	39,656,634	7,160,742	30,841,500	21,745,686	215	
114	Southwestern Gas and Electric Company	10	44,265	0	0	296,354,520	224,956,607	71,397,913	0	6,950,522	34,732,941	12,643,063	242,027,994	(f)	f 41,526,273	(d)	d 182,857,775	3,299,675	7,568,251	6,776,020	(f)	f
115	West Texas Utilities Company	17	53,162	0	0	293,348,233	286,765,422	6,582,811	0	8,996,784	45,879,250	93,221,523	145,250,676	578,965	31,402,642	28,411,124	77,541,022	1,685,978	26,014	5,604,931	353	
116	Louisiana Steam Generating Corp.	1	45,000	0	0	293,082,200	293,082,200	0	0	0	2,300	162,378,500	130,701,400	0	0	0	130,701,400	0	0	0	0	
117	Central Power and Light Company (Texas)	29	61,183	5	15,000	287,743,979	251,059,056	36,684,923	0	29,230,080	58,799,676	13,125,410	186,588,813	5,428,433	36,034,088	49,265,706	85,336,831	2,256,536	0	8,267,219	4,299	
118	Public Service Company of Oklahoma	12	76,580	0	0	272,179,327	238,169,817	34,009,510	0	2,432,271	37,384,559	31,203,549	201,158,948	1,363,497	41,425,319	23,209,723	131,713,591	2,754,848	691,970	0	1,015	
119	San Antonio Public Service Company	4	98,300	2	700	231,221,760	184,160,760	47,061,000	0	1,671,248	32,077,649	19,025,790	178,447,073	2,225,057	37,144,966	y 86,031,015	z 51,115,795	1,930,240	0	0	1,360	
120	El Paso Electric Company	4	56,529	0	0	137,293,926	137,233,926	60,000	5,272,941	1,260,650	15,550,124	9,352,399	105,857,812	1,960,882	17,759,333	23,992,590	58,686,250	1,246,346	0	2,212,411	1,236	
	Totals for section	160	1,381,908	14	82,251	6,562,175,519	5,785,350,627	776,824,892	40,469,141	84,155,502	860,796,463	1,127,142,563	4,449,611,850	44,821,341	673,040,855	854,001,994	2,538,197,936	138,424,634	95,507,903	105,617,187	34,177	
	Rocky Mountain States																					
121	Montana Power Co. (*A*)	1	500	12	293,500	1,559,436,000	1,276,285,000	283,151,000	0	(v)	v 226,256,844	2,341,720	1,330,837,436	3,228,475	51,746,423	48,572,849	906,800,000	7,655,194	101,871,576	e 210,962,919	2,451	
122	Bureau of Reclamation (Boulder Dam)	0	0	1	370,000	1,166,681,000	1,166,681,000	0	0	1,827,025	10,329,240	1,150,587,020	3,937,715	0	c 3,644,915	(c)	292,800	0	0	0	0	c
123	Utah Power & Light Co. (*A*)	6	61,800	31	179,342	919,184,148	608,530,992	310,653,156	0	4,374,048	134,715,539	7,538,232	772,556,329	12,283,273	77,184,259	d 640,225,753	(d)	6,865,259	25,622,470	10,375,915	15,275	
124	Idaho Power Co. (*A*)	2	260	13	100,725	609,465,506	581,966,829	27,498,677	b 17,278,611	4,622,712	79,333,212	317,493,420	190,737,551	26,402,675	50,454,892	(d)	d 111,273,235	2,606,749	0	0	12,701	
125	Salt River Valley Water Users' Association	0	0	8	70,050	496,413,616	302,071,980	194,341,636	0	0	64,027,276	111,729,147	320,657,193	10,161,745	0	w 85,214,848	183,009,831	w 34,499,443	0	7,771,326	5,670	
126	Public Service Company of Colorado	10	83,907	10	42,655	472,369,456	466,125,016	6,244,440	0	4,979,183	66,821,585	38,983,191	361,585,497	3,927,870	63,370,790	57,393,939	228,253,459	8,639,439	0	0	3,119	
127	Central Arizona Light Co. (*A*)	1	15,000	0	0	125,061,000	4,817,000	120,244,000	0	0	15,420,000	0	109,641,000	5,983,000	19,509,000	19,571,000	54,635,000	2,037,000	2,392,000	5,514,000	795	
	Totals for section	20	161,467	75	1,056,272	5,348,610,726	4,406,477,817	942,132,909	17,278,611	15,802,968	596,903,696	1,628,672,730	3,089,952,721	61,987,038	265,910,279	850,978,389	1,484,264,325	62,303,084	129,886,046	234,623,560	40,011	
	Pacific States																					
128	Pacific Gas and Electric Co. (Consolidated System)	10	374,175	49	876,794	5,182,043,123	4,108,914,140	1,073,128,983	5,004,731	64,049,662	1,177,185,293	208,183,940	3,727,619,497	641,529,693	608,920,209	679,112,591	1,492,827,178	60,351,419	239,079,603	C 5,798,804	37,369	
129	Southern California Edison Company, Ltd.	L 4	L 439,250	23	492,300	3,138,653,552	3,124,333,917	14,319,635	0	0	651,104,055	140,632,200	2,617,911,437	0	0	0	0	0	0	0	15,739	

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109	Texas Electric Service Co. (*A*)	11	98,078	0	0	477,809,000	463,306,000	14,503,000		0	0	83,735,000	37,767,000	356,307,000	1,708,000	49,824,000	71,325,000	201,617,000	25,579,000	6,254,000	0	1,854		
110	Arkansas Power & Light Co. (*A*)	19	42,848	3	65,666	452,466,000	205,340,000	247,126,000		0	7,905,000	77,776,000	65,249,000	301,536,000	2,203,000	34,857,000	42,396,000	208,357,000	13,723,000	0	0	2,629		
111	New Orleans Public Service, Inc. (*A*)	1	108,000	0	0	444,434,000	444,434,000	0		35,137,000	4,045,411	39,325,142	114,858,796	251,067,651	0	46,319,846	84,353,096	94,552,795	25,841,914	0	0	0		
112	Gulf States Utilities Company	10	75,596	0	0	367,401,350	250,131,115	117,270,235	*H*	59,200	7,880,108	54,783,953	26,206,669	278,471,420	242,645	42,955,740	36,673,905	190,945,929	1,354,011	1,239,770	5,059,420	44		
113	Dallas Power & Light Co. (*A*)	1	82,500	0	0	308,008,316	308,267,700	—259,384		0	3,400,283	31,855,286	0	272,752,747	248,490	58,381,694	114,718,001	39,656,634	7,160,742	30,841,500	21,745,686	215		
114	Southwestern Gas and Electric Company	10	44,265	0	0	296,354,520	224,956,607	71,397,913		0	6,950,522	34,732,941	12,643,063	242,027,994	(*f*)	*f* 41,526,273	(*d*)	*d* 182,857,775	3,299,675	7,568,251	6,776,020	(*f*)	*f*	
115	West Texas Utilities Company	17	53,162	0	0	293,348,233	286,765,422	6,582,811		0	8,996,784	45,879,250	93,221,523	145,250,676	578,965	31,402,642	28,411,124	77,541,022	1,685,978	26,014	5,604,931	353		
116	Louisiana Steam Generating Corp.	1	45,000	0	0	293,082,200	293,082,200	0		0	0	2,300	162,378,500	130,701,400	0	0	0	130,701,400	0	0	0	0		
117	Central Power and Light Company (Texas)	29	61,183	5	15,000	287,743,979	251,059,056	36,684,923		0	29,230,080	58,799,676	13,125,410	186,588,813	5,428,433	36,034,088	49,265,706	85,336,831	2,256,536	0	8,267,219	4,299		
118	Public Service Company of Oklahoma	12	76,580	0	0	272,179,327	238,169,817	34,009,510		0	2,432,271	37,384,559	31,203,549	201,158,948	1,363,497	41,425,319	23,209,723	131,713,591	2,754,848	691,970	0	1,015		
119	San Antonio Public Service Company	4	98,300	2	700	231,221,760	184,160,760	47,061,000		0	1,671,248	32,077,649	19,025,790	178,447,073	2,225,057	37,144,966	*y* 86,031,015	*z* 51,115,795	1,930,240	0	0	1,360		
120	El Paso Electric Company	4	56,529	0	0	137,293,926	137,233,926	60,000		5,272,941	1,260,650	15,550,124	9,352,399	105,857,812	1,960,882	17,759,333	23,992,590	58,686,250	1,246,346	0	2,212,411	1,236		
	Totals for section	160	1,381,908	14	82,251	6,562,175,519	5,785,350,627	776,824,892		40,469,141	84,155,502	860,796,463	1,127,142,563	4,449,611,850	44,821,341	673,040,855	854,001,994	2,538,197,936	138,424,634	95,507,903	105,617,187	34,177		
	Rocky Mountain States																							
121	Montana Power Co. (*A*)	1	500	12	293,500	1,559,436,000	1,276,285,000	283,151,000		0	(*e*)	*e*	226,256,844	2,341,720	1,330,837,436	3,228,475	51,746,423	48,572,849	906,800,000	7,655,194	101,871,576	*e*	210,962,919	2,451
122	Bureau of Reclamation (Boulder Dam)	0	0	1	370,000	1,166,681,000	1,166,681,000	0		0	1,827,025	10,329,240	1,150,587,020	3,937,715	0	*c* 3,644,915	(*c*)	292,800	0	0	0	0		*c*
123	Utah Power & Light Co. (*A*)	6	61,800	31	179,342	919,184,148	608,530,992	310,653,156		0	4,374,048	134,715,539	7,538,232	772,556,329	12,283,273	77,184,259	*d* 640,225,753	(*d*)	6,865,259	25,622,470	10,375,515	15,275		
124	Idaho Power Co. (*A*)	2	260	13	100,725	609,465,506	581,966,829	27,498,677	*b*	17,278,611	4,622,712	79,333,212	317,493,420	190,737,551	26,402,675	50,454,892	(*d*)	*d* 111,273,235	2,606,749	0	0	12,701		
125	Salt River Valley Water Users' Association	0	0	8	70,050	496,413,616	302,071,980	194,341,636		0	0	64,027,276	111,729,147	320,657,193	10,161,745	0	*w* 85,214,848	183,009,831	*w* 34,499,443	0	7,771,326	5,670		
126	Public Service Company of Colorado	10	83,907	10	42,655	472,369,456	466,125,016	6,244,440		0	4,979,183	66,821,585	38,983,191	361,585,497	3,927,870	63,370,790	57,393,939	228,253,459	8,639,439	0	0	3,119		
127	Central Arizona Light Co. (*A*)	1	15,000	0	0	125,061,000	4,817,000	120,244,000		0	0	15,420,000	0	109,641,000	5,983,000	19,509,000	19,571,000	54,635,000	2,037,000	2,392,000	5,514,000	795		
	Totals for section	20	161,467	75	1,056,272	5,348,610,726	4,406,477,817	942,132,909		17,278,611	15,802,968	596,903,696	1,628,672,730	3,089,952,721	61,987,038	265,910,279	850,978,389	1,484,264,325	62,303,084	129,886,046	234,623,560	40,011		
	Pacific States																							
128	Pacific Gas and Electric Co. (Consolidated System)	10	374,175	49	876,794	5,182,043,123	4,108,914,140	1,073,128,983		5,004,731	64,049,662	1,177,185,293	208,183,940	3,727,619,497	641,529,693	608,920,209	679,112,591	1,492,827,178	60,351,419	239,079,603	*C*	5,798,804	37,369	
129	Southern California Edison Company, Ltd.	*L* 4	*L* 439,250	23	492,300	3,138,653,552	3,124,333,917	14,319,635		0	0	651,106,065	140,536,290	2,347,011,197	391,098,810	369,127,447	247,983,753	1,025,137,194	40,106,358	267,013,071		6,544,564	15,739	
130	City of Los Angeles, Dept. of Water & Power, Bur. of Pwr. & Lt.	3	187,500	6	374,605	1,506,170,763	1,494,948,015	11,222,748		0	9,523,501	252,491,486	20,585,630	*i*1,223,570,146	0	256,952,732	644,241,698	272,083,258	56,330,683	*i* —19,503,748	13,465,523	0		
131	Washington Water Power Co. (*A*)	0	0	12	203,534	1,278,809,472	1,097,420,920	181,388,552		0	1,787,340	233,798,711	365,850,665	677,372,756	19,239,807	107,211,783	89,199,242	411,381,375	6,350,617	43,989,932	0	5,640		
132	Puget Sound Power & Light Company	3	104,500	13	215,245	1,233,900,630	1,228,112,882	5,787,748		1,970,620	13,617,260	234,368,888	*o* 151,755,482	832,188,380	43,575,611	159,425,053	211,074,007	335,341,144	5,372,724	59,937,368	17,462,473	30,201		
133	Portland General Electric Company	3	90,000	5	93,190	704,759,000	698,006,000	6,753,000		57,941	2,163,576	117,206,178	21,312,115	564,019,190	(*f*)	*f* 130,059,199	(*d*)	*d*, *f* 349,978,147	12,307,939	55,089,029	16,584,876	(*f*)	*f*	
134	The California Oregon Power Company	2	15,350	12	100,080	575,584,904	554,778,144	20,806,760		0	3,731,838	87,557,238	341,269,510	143,026,318	21,330,377	37,906,501	17,261,680	64,748,478	1,483,318	0	295,964	5,038		
135	Hetch Hetchy Water Supply, San Francisco	0	0	2	83,300	506,711,800	506,711,800	0		0	641,838	30,235,747	469,742,400	6,091,815	0	0	0	0	0	0	6,091,815	0		
136	Northwestern Electric Co. (*A*)	2	42,500	1	9,600	439,684,223	180,818,189	258,866,034		0	5,180,887	48,783,632	81,552,610	304,167,094	2,847,193	44,669,514	95,476,885	153,690,266	1,474,824	0	6,008,412	4,237		
137	The Nevada-California Electric Corporation	3	8,210	12	*M* 93,125	439,237,287	338,318,149	*M* 100,919,138	*k*	1,653,208	8,386,087	109,471,717	43,468,884	276,257,391	43,734,566	31,718,639	40,445,489	106,539,898	885,787	52,929,287	3,725	1,416		
138	City of Seattle — Department of Lighting	1	30,000	4	209,000	419,977,000	417,285,000	2,692,000		0	(*J*)	88,781,417	23,600	331,171,983	0	102,604,026	77,761,844	98,037,769	19,789,596	32,978,748	0	0		
139	City of Tacoma (Light Dept.)	2	34,000	3	124,000	374,838,353	374,811,353	27,000		0	1,185,110	57,338,936	9,755,713	306,558,594	0	52,367,632	39,722,614	206,193,350	7,158,538	1,116,460	0	0		
140	Pacific Power & Light Co. (*A*)	1	8,000	9	22,567	320,128,084	156,091,510	164,036,574		0	5,033,648	61,830,133	70,745,451	182,518,852	20,261,002	59,031,328	98,538,172	0	3,090,000	1,598,350	0	10,594		
141	Inland Power & Light Co. (*A*)	0	0	2	45,800	267,171,844	267,149,954	21,890		0	0	174,830	266,997,014	0	0	0	0	0	0	0	0	0		
142	San Diego Consolidated Gas & Electric Company	2	74,000	0	0	235,656,875	220,535,400	15,121,475		0	3,246,344	35,666,327	1,054,488	195,689,716	(*f*)	*f* 57,706,688	*f* 46,357,183	*f* 63,275,999	5,899,347	15,571,000	6,879,499	(*f*)	*f*	
143	Turlock-Modesto Irrigation Districts	1	1,000	2	34,000	174,311,610	173,591,610	720,000		0	13,547,178	16,768,308	83,520,480	60,475,644	(*P*)	(*P*)	(*P*)	(*P*)	(*P*)	(*P*)	*P* 60,475,644	(*P*)		
144	Merced Irrigation District	0	0	2	*X* 31,250	138,969,650	138,969,650	0		0	0	0	138,969,650	0	0	0	0	0	0	0	0	0		
145	Washington Gas and Electric Company	1	27,000	1	50	138,951,750	132,847,830	6,103,920		0	1,317,464	5,581,365	0	132,052,921	0	4,019,434	2,675,050	124,871,846	486,591	0	0	0		
146	East Bay Municipal Utility District	0	0	1	15,000	106,112,929	106,112,929	0		0	0	0	106,112,929	0	0	0	0	0	0	0	0	0		
	Totals for section	38	1,435,485	159	3,023,440	17,181,672,849	15,319,757,392	1,861,915,457		8,686,500	133,411,733	3,208,346,271	2,521,436,851	11,309,791,494	1,183,617,059	2,021,720,185	2,289,850,208	4,704,105,902	221,087,741	749,799,100	139,611,299	110,234		
	Canada																							
147	Hydro-Electric Power Commission of Ontario (*g*)	1	20,000	45	1,131,870	7,842,342,668	6,218,307,978	1,624,034,690																
148	Shawinigan Water & Power Co. and Subsidiaries	0	0	18	689,687	5,875,289,115	4,378,863,565	1,496,425,550		4,800,000	23,107,155	429,190,804	655,365,601	4,762,825,555	3,449,728	57,995,875	56,100,945	2,729,850,012	7,235,038	0	*Q* 1,908,193,957	13,184		
149	Gatineau Power Company	1	6,750	18	506,921	3,023,365,532	3,020,691,862	2,673,670		0	0	69,169,176	987,108,032	1,967,088,324	779,249	10,482,769	7,632,938	1,940,771,440	1,243,345	3,302,580	2,876,003	0		
150	Saguenay Power Company, Ltd.	0	0	1	420,000	2,586,183,600	2,364,317,000	221,866,600		0	0	28,871,883	645,960,695	1,911,351,022	0	0	0	1,911,351,022	0	0	0	0		
151	Montreal Light, Heat & Power Consolidated	1	16,500	4	215,410	2,517,938,131	965,872,470	1,552,065,661		0	0	146,163,994	521,642,382	*j*1,850,131,755	(*f*)	*f* 130,171,613	222,099,291	1,362,116,862	16,001,312	119,742,677	0	(*f*)	*f*	
152	Alcoa Power Company, Limited	0	0	1	200,000	1,486,071,141	1,486,071,141	0		0	0	91,657,196	249,627,900	1,144,786,045	0	233,141	0	0	0	0	1,144,552,904	0		
153	West Kootenay Power and Light Co., Ltd.	0	0	5	179,625	1,063,113,331	1,062,549,857	563,474		0	1,102,685	113,998,147	6,833,434	941,179,065	1,210,882	4,538,288	2,821,060	932,119,906	488,929	0	0	26		
154	Winnipeg Electric Company (*W*)	1	*X* 12,000	3	*X* 251,100	867,604,882	867,604,882	0		0	0	87,584,075	54,489,255	725,531,552	0	98,171,647	41,707,174	216,012,024	1,712,374	37,192,906	330,735,427	0		
155	Beauharnois Light, Heat & Power Company	0	0	1	311,200	832,510,045	832,510,045	0		0	0	5,078,592	638,092,490	189,338,963	0	0	0	189,338,963	0	0	0	0		
156	Canada Northern Power Corporation, Limited	0	0	9	94,375	649,123,556	475,339,556	173,784,000		0	0	47,142,322	0	601,981,234	0	19,322,515	14,219,605	567,207,858	1,231,256	0	0	0		
157	Canadian Niagara Power Company, Ltd. (*g*)	0	0	1	75,000	633,967,900	633,967,900																	
158	Winnipeg Hydro Electric System (Municipal)	*T* 1	*T* 11,190	2	132,000	554,812,892	527,430,454	27,382,438		0	(*J*)	71,187,048	564,960	483,060,884	0	193,507,198	77,312,793	53,124,147	14,884,546	0	*U* 144,232,200	0		
159	British Columbia Electric Railway Co., Ltd. (*Y*)	1	17,500	5	167,325	488,160,300	488,160,300	0		85,432,722	9,606,954	37,935,604	7,790,527	347,394,493	0	91,298,666	71,997,105	172,911,420	11,187,302	0	0	0		
160	Great Lakes Power Company, Limited	0	0	3	46,700	267,395,139	267,395,139	0		1,116,389	14,280	7,740,038	17,955,000	240,569,432	44,882	182,292	129,355	240,171,876	41,027	0	0	107		
161	Southern Canada Power Co., Ltd.	0	0	5	43,865	247,781,330	220,645,980	27,135,350		0	1,179,720	37,440,450	75,582,360	133,578,800	720,240	16,389,020	*y* 8,596,920	*z* 84,286,520	2,994,500	0	*Q* 20,591,600	1,366		
162	Montreal Island Power Company	0	0	1	45,000	245,268,100	245,268,100	0		0	0	0	245,268,100	0	0	0	0	0	0	0	0	0		
163	The Nova Scotia Power Commission	3	*Z* 107	13	*Z* 67,255	219,096,554	219,096,554	0		0	0	10,279,424	0	208,817,130	0	(*c*)	*c* 662,077	162,378,486	47,330	0	45,729,237	0		
164	Calgary Power Company, Limited	5	*X* 14,027	3	*X* 53,000	129,839,088	126,312,410	3,526,678		0	515,000	21,091,716	84,843,590	23,388,782	271,228	3,689,022	6,842,094	11,393,292	1,193,146	0	0	295		
	Totals for Canada	14	98,074	138	4,630,333	29,529,863,304	24,400,405,193	5,129,458,111		91,349,111	35,525,794	1,204,530,469	4,191,124,326	15,531,023,036	6,476,209	625,982,046	510,121,357	10,573,033,828	58,260,105	160,238,163	3,596,911,328	14,978		
	Mexico																							
165	The Mexican Light and Power Co., Ltd., and Subsidiary Cos.	1	30,000	15	207,000	1,161,261,933	1,159,970,985	1,290,948		0	14,599,853	473,469,748	0	673,192,332	*E* 1,562,860	70,982,352	35,515,370	3,754,380	13,178,525	77,667,358	470,531,487	129		
	Revised Statistics for 1936																							
38a	Commonwealth Edison Group	13	1,818,900	4	7,000	6,502,175,000	6,459,914,000	42,261,000		0	(*p*)	*p* 841,669,000	654,466,000	5,006,040,000	0	0	0	0	0	0	0	0		
25a	New York State Electric and Gas Corp. & Affiliates	9	81,510	25	22,315	726,324,398	405,331,970	320,992,428		3,697,762	5,544,032	113,590,320	61,315,216	542,177,068	0	0	0	0	0	0	0	0		
28a	Long Island Lighting System	6	166,500	0	0	308,571,614	308,559,917	11,697		0	5,841,524	63,722,023	1,290,705	237,717,362	0	94,628,717	50,774,510	57,693,624	20,543,909	14,073,000	3,602	0		
139a	City of Tacoma, Light Department	2	34,000	3	114,000	312,662,798	312,441,798	221,000		1,134,395	1,073,172	47,383,473	25,996,421	237,075,337	0	48,522,830	38,970,718	142,442,843	7,138,946	0	0	0		
	Electric Railways and Electrified Railroads																							
166	Interborough Rapid Transit Co.	2	390,000	0	0	1,090,188,836	1,090,092,580	96,256																
167	Pennsylvania Railroad	1	88,000	0	0	*G* 840,211,953	262,754,235	*G* 577,457,718																
168	Chicago Surface Lines	0	0	0	0	658,056,629	0	658,056,629																
169	Williamsburgh Power Plant Corp. (B.M.T.)	2	201,400	0	0	605,556,117	605,379,805	176,312																
170	Board of Transportation (N. Y. City Subway System)	0	0	0	0	375,134,980	0	375,134,980																
171	Philadelphia Rapid Transit Company	0	0	0	0	318,748,423	0	318,748,423																
172	The New York Central Railroad Co.	0	0	0	0	240,715,739	0	240,715,739																
173	Boston Elevated Railway	2	180,000	0	0	223,998,060	219,630,060	4,368,000																
174	New York, New Haven & Hartford R. R. Co.	1	43,000	0	0	180,201,900	86,385,500	93,816,400																
175	Pacific Electric Railway Company	0	0	0	0	146,218,748	0	146,218,748																
176	St. Louis Public Service Company	0	0	0	0	138,922,560	0	138,922,560																
177	Norfolk & Western Railway Company	6	43,855	0	0	137,715,998	98,910,454	38,805,544																
178	Twin City Rapid Transit Company	1	75,000	2	*L* 16,000	128,618,335	92,785,660	*B* 35,832,675																
179	Chicago, Milwaukee, St. Paul & Pacific R. R. Co.	0	0	0	0	116,990,371	0	116,990,371																
180	The Virginian Railway Company	1	*X* 50,000	0	0	99,650,100	99,650,100	0																
	Totals for railways and railroads	16	1,071,255	2	16,000	5,300,928,749	2,555,588,394	2,745,340,355																

SUMMARY OF GENERATOR RATING AND OUTPUT OF LARGE UTILITY SYSTEMS

Region	No. Cos. or Systems	Number of Generating Plants and Generator Rating — All Plants: No.	All Plants: Rating, Kw.	Fuel Plants: No.	Fuel Plants: Rating, Kw.	Hydro Plants: No.	Hydro Plants: Rating, Kw.	Output Gen. and Purch., Kw.-Hr.	Energy Generated (Net) Kw.-Hr.
United States	**146**	**1,761**	**31,673,885**	**866**	**22,159,983**	**895**	**9,513,902**	**122,164,821,065**	**108,530,367,986**
New England	15	177	2,322,473	45	1,586,787	132	735,686	8,092,971,297	6,831,721,444
Middle Atlantic	22	315	8,893,978	128	7,060,441	187	1,833,537	34,318,709,232	31,094,663,105
East North Central	28	314	7,559,817	148	7,067,369	166	492,448	29,657,272,116	27,656,049,495
West North Central	15	228	2,206,587	149	1,655,490	79	551,097	7,334,003,055	7,090,345,751
South Atlantic (*g*)	14	151	1,942,639	94	1,210,680	57	731,959	7,895,104,616	5,592,157,448
East South Central	10	110	1,607,568	84	600,356	26	1,007,212	5,774,301,655	4,753,844,907
West South Central	16	174	1,464,159	160	1,381,908	14	82,251	6,562,175,519	5,785,350,627
Mountain	7	95	1,217,739	20	161,467	75	1,056,272	5,348,610,726	4,406,477,817
Pacific	19	197	4,458,925	38	1,435,485	159	3,023,440	17,181,672,849	15,319,757,392
Canada (*g*)	**18**	**152**	**4,728,407**	**14**	**98,074**	**138**	**4,630,333**	**29,529,863,304**	**24,400,405,193**
Mexico	**1**	**16**	**237,000**	**1**	**30,000**	**15**	**207,000**	**1,161,261,933**	**1,159,970,985**
Railways and Railroads	**15**	**18**	**1,087,255**	**16**	**1,071,255**	**2**	**16,000**	**5,300,928,749**	**2,555,588,394**

0	477,809,000	463,306,000	14,503,000		0	(o) 0	83,735,000	37,767,000	356,307,000	1,708,000	49,824,000	71,325,000	201,617,000	25,579,000	6,254,000	0	1,834	71,313	12,736	1,207	774	87,864	109
65,666	452,466,000	205,340,000	247,126,000		0	7,905,000	77,776,000	65,249,000	301,536,000	2,203,000	34,857,000	42,396,000	208,357,000	13,723,000	0	0	2,629	53,145	15,452	754	1,292	73,272	110
0	444,434,000	444,434,000	0		35,137,000	4,045,411	39,325,142	114,858,796	251,067,651	0	46,319,846	84,353,096	94,552,795	25,841,914	0	0	0	86,134	14,598	1,339	512	102,583	111
0	367,401,350	250,131,115	117,270,235	H	59,200	7,880,108	54,783,953	26,206,669	278,471,420	242,645	42,955,740	36,673,905	190,945,929	1,354,011	1,239,770	5,059,420	44	46,162	9,807	404	53	56,470	112
0	308,008,316	308,267,700	—259,384		0	3,400,283	31,855,286	0	272,752,747	248,490	58,381,694	114,718,001	39,656,634	7,160,742	30,841,500	21,745,686	215	69,377	9,015	1,002	365	79,974	113
0	296,354,520	224,956,607	71,397,913		0	6,950,522	34,732,941	12,643,063	242,027,994	(f)	f 41,526,273	(d)	d 182,857,775	3,299,675	7,568,251	6,776,020	(f)	f 57,224	(d)	d 14,404	360	71,988	114
0	293,348,233	286,765,422	6,582,811		0	8,996,784	45,879,250	93,221,523	145,250,676	578,965	31,402,642	28,411,124	77,541,022	1,685,978	26,014	5,604,931	353	36,208	11,161	1,068	678	49,468	115
0	293,082,200	293,082,200	0		0	0	2,300	162,378,500	130,701,400	0	0	0	130,701,400	0	0	0	0	0	0	3	0	3	116
15,000	287,743,979	251,059,056	36,684,923		0	29,230,080	58,799,676	13,125,410	186,588,813	5,428,433	36,034,088	49,265,706	85,336,831	2,256,536	0	8,267,219	4,299	45,366	16,811	1,044	245	67,765	117
0	272,179,327	238,169,817	34,009,510		0	2,432,271	37,384,559	31,203,549	201,158,948	1,363,497	41,425,319	23,209,723	131,713,591	2,754,848	691,970	0	1,015	53,903	d 12,486	(d)	68	67,472	118
700	231,221,760	184,160,760	47,061,000		0	1,671,248	32,077,649	19,025,790	178,447,073	2,225,057	37,144,966	y 86,031,015	z 51,115,795	1,930,240	0	0	1,360	59,637	y 11,100	z 218	0	72,315	119
0	137,293,926	137,233,926	60,000		5,272,941	1,260,650	15,550,124	9,352,399	105,857,812	1,960,882	17,759,333	23,992,590	58,686,250	1,246,346	0	2,212,411	1,236	19,005	3,519	200	8	23,968	120
82,251	6,562,175,519	5,785,350,627	776,824,892		40,469,141	84,155,502	860,796,463	1,127,142,563	4,449,611,850	44,821,341	673,040,855	854,001,994	2,538,197,936	138,424,634	95,507,903	105,617,187	34,177	943,145	185,123	34,550	9,464	1,206,459	
293,500	1,559,436,000	1,276,285,000	283,151,000		0	(v)	v 226,256,844	2,341,720	1,330,837,436	3,228,475	51,746,423	48,572,849	906,800,000	7,655,194	101,871,576	e 210,962,919	2,451	65,228	10,755	1,066	1,051	80,551	121
370,000	1,166,681,000	1,166,681,000	0		0	1,827,025	10,329,240	1,150,587,020	3,937,715	0	c 3,644,915	(c)	292,800	0	0	0	0	c 675	(c)	1	0	676	122
179,342	919,184,148	608,530,992	310,653,156		0	4,374,048	134,715,539	7,538,232	772,556,329	12,283,273	77,184,259	d 640,225,753	(d)	6,865,259	25,622,470	10,375,915	15,275	78,738	d 10,693	(d)	1,071	105,777	123
100,725	609,465,506	581,966,829	27,498,677	b	17,278,611	4,622,712	79,333,212	317,493,420	190,737,551	26,402,675	50,454,892	(d)	d 111,273,235	2,606,749	0	0	12,701	33,931	(d)	d 7,329	45	54,006	124
70,050	496,413,616	302,071,980	194,341,636		0	0	64,027,276	111,729,147	320,657,193	10,161,745	0	w 85,214,848	183,009,831	w 34,499,443	0	7,771,326	5,670	0	w 274	25	27	5,996	125
42,655	472,369,456	466,125,016	6,244,440		0	4,979,183	66,821,585	38,983,191	361,585,497	3,927,870	63,370,790	57,393,939	228,253,459	8,639,439	0	0	3,119	105,466	15,926	6,733	60	131,304	126
0	125,061,000	4,817,000	120,244,000		0	0	0	15,420,000	109,641,000	5,983,000	19,570,000	19,571,000	54,635,000	2,037,000	2,392,000	5,514,000	795	22,449	2,529	1,123	150	27,046	127
,056,272	5,348,610,726	4,406,477,817	942,132,909		17,278,611	15,802,968	596,903,696	1,628,672,730	3,089,952,721	61,987,038	265,910,279	850,978,389	1,484,264,325	62,303,084	129,886,046	234,623,560	40,011	306,487	40,177	16,277	2,404	405,356	
876,794	5,182,043,123	4,108,914,140	1,073,128,983		5,004,731	64,049,662	1,177,185,293	208,183,940	3,727,619,497	641,529,693	608,920,209	679,112,591	1,492,827,178	60,351,419	239,079,603	C 5,798,804	37,369	666,112	130,997	5,295	979	840,752	128
492,300	3,138,653,552	3,124,333,917	14,319,635		0	0	651,106,065	140,536,290	2,347,011,197	391,098,810	369,127,447	247,983,753	1,025,137,194	40,106,358	267,013,071	6,544,564	15,739	430,169	60,010	23,716	374	530,008	129
374,605	1,506,170,763	1,494,948,015	11,222,748		0	9,523,501	252,491,486	20,585,630	i1,223,570,146	0	256,952,732	244,241,698	272,083,258	56,330,683	i—19,503,748	13,465,523	0	346,785	83,727	2,783	909	434,204	130
203,534	1,278,809,472	1,097,420,920	181,388,552		0	1,787,340	233,798,711	365,850,665	677,372,756	19,239,807	107,211,783	89,199,242	411,381,375	6,350,617	43,989,932	0	5,640	58,817	9,835	607	86	74,985	131
215,245	1,233,900,630	1,228,112,882	5,787,748		1,970,620	13,617,260	234,368,888	o 151,755,482	832,188,380	43,575,611	159,425,053	211,074,007	335,341,144	5,372,724	59,937,368	17,462,473	30,201	130,755	22,443	647	195	184,241	132
93,190	704,759,000	698,006,000	6,753,000		57,941	2,163,576	117,206,178	21,312,115	564,019,190	(f)	f 130,059,199	(d)	d, f 349,978,147	12,307,939	55,089,029	16,584,876	(f)	f 102,757	(d)	d, f 12,826	852	116,435	133
100,080	575,584,904	554,778,144	20,806,760		0	3,731,838	87,557,238	341,269,510	143,026,318	21,330,377	37,906,501	17,261,680	64,748,478	1,483,318	0	295,964	5,038	20,561	5,037	1,275	70	31,981	134
83,300	506,711,800	506,711,800	0		0	641,838	30,235,747	469,742,400	6,091,815	0	0	0	0	0	0	6,091,815	0	0	0	0	62	62	135
9,600	439,684,223	180,818,189	258,866,034		0	5,180,887	48,783,632	81,552,610	304,167,094	2,847,193	44,669,514	95,476,885	153,690,266	1,474,824	0	6,008,412	4,237	34,523	6,083	4	207	45,054	136
93,125	439,237,287	338,318,149	M100,919,138	k	1,653,208	8,386,087	109,471,717	43,468,884	276,257,391	43,734,566	31,718,639	40,445,489	106,539,898	885,787	52,929,287	3,725	1,416	28,249	7,320	38	128	37,151	137
209,000	419,977,000	417,285,000	2,692,000		0	(f)	88,781,417	23,600	331,171,983	0	102,604,026	77,761,844	98,037,769	19,789,596	32,978,748	0	0	83,919	9,415	3,177	367	96,878	138
124,000	374,838,353	374,811,353	27,000		0	1,185,110	57,338,936	9,755,713	306,558,594	0	52,367,632	39,722,614	206,193,350	7,158,538	1,116,460	0	0	31,382	5,094	86	2	36,564	138
22,567	320,128,084	156,091,510	164,036,574		0	5,033,648	61,830,133	70,745,451	182,518,852	20,261,002	59,031,328	98,538,172	0	3,090,000	1,598,350	0	10,594	41,040	8,986	0	75	60,695	140
45,800	267,171,844	267,149,954	21,890		0	0	174,830	266,997,014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141
0	235,656,875	220,535,400	15,121,475		0	3,246,344	35,666,327	1,054,488	195,689,716	(f)	f 57,706,688	f 46,357,183	f 63,275,999	5,899,347	15,571,000	6,879,499	(f)	f 70,967	f 12,822	f 5,023	34	88,846	142
34,000	174,311,610	173,591,610	720,000		0	13,547,178	16,768,308	83,520,480	60,475,644	(P)	(P)	(P)	(P)	(P)	(P)	P 60,475,644	(P)	(P)	(P)	(P)	P 16,344	P 16,344	143
31,250	138,969,650	138,969,650	0		0	0	0	138,969,650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	144
50	138,951,750	132,847,830	6,103,920		0	1,317,464	5,581,365	0	132,052,921	0	4,019,434	2,675,050	124,871,846	486,591	0	0	0	4,313	484	141	2	4,940	145
15,000	106,112,929	106,112,929	0		0	0	0	106,112,929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146
,023,440	17,181,672,849	15,319,757,392	1,861,915,457		8,686,500	133,411,733	3,208,346,271	2,521,436,851	11,309,791,494	1,183,617,059	2,021,720,185	2,289,850,208	4,704,105,902	221,087,741	749,799,100	139,611,299	110,234	2,050,349	362,253	55,618	20,686	2,599,140	
,131,870	7,842,342,668	6,218,307,978	1,624,034,690																				147
,689,687	5,875,289,115	4,378,863,565	1,496,425,550		4,800,000	23,107,155	429,190,804	655,365,601	4,762,825,555	3,449,728	57,995,875	56,100,945	2,729,850,012	7,235,038	0	Q1,908,193,957	13,184	80,692	22,041	384	344	116,645	148
506,921	3,023,365,532	3,020,691,862	2,673,670		0	0	69,169,176	987,108,032	1,967,088,324	779,249	10,482,769	7,632,938	1,940,771,440	1,243,345	3,302,580	2,876,003	0	0	0	0	0	0	149
420,000	2,586,183,600	2,364,317,000	221,866,600		0	0	28,871,883	645,960,695	1,911,351,022	0	0	0	1,911,351,022	0	0	0	0	0	0	4	0	4	150
215,410	2,517,938,131	965,872,470	1,552,065,661		0	0	146,163,994	521,642,382	j1,850,131,755	(f)	f 130,171,613	222,099,291	1,362,116,862	16,001,312	119,742,677	0	(f)	f 219,375	42,409	402	31	262,217	151
200,000	1,486,071,141	1,486,071,141	0		0	0	91,657,196	249,627,900	1,144,786,045	0	233,141	0	0	0	0	1,144,552,904	0	13	0	0	5	18	152
179,625	1,063,113,331	1,062,549,857	563,474		0	1,102,685	113,998,147	6,833,434	941,179,065	1,210,882	4,538,288	2,821,060	932,119,906	488,929	0	0	26	5,254	1,057	25	5	6,367	153
251,100	867,604,882	867,604,882	0		0	0	87,584,075	54,489,255	725,531,552	0	98,171,647	41,707,174	216,012,024	1,712,374	37,192,906	330,735,427	0	22,515	4,439	1,431	27	28,412	154
311,200	832,510,045	832,510,045	0		0	0	5,078,592	638,092,490	189,338,963	0	0	0	189,338,963	0	0	0	0	0	0	4	3	7	155
94,375	649,123,556	475,339,556	173,784,000		0	0	47,142,322	0	601,981,234	0	19,322,515	14,219,605	567,207,858	1,231,256	0	0	0	16,340	3,381	61	15	19,797	156
75,000	633,967,900	633,967,900																					157
132,000	554,812,892	527,430,454	27,382,438		0	(f)	71,187,048	564,960	483,060,884	0	193,507,198	77,312,793	53,124,147	14,884,546	0	U144,232,200	0	40,761	6,126	(V)	6	46,893	158
167,325	488,160,300	488,160,300	0		85,432,722	9,606,954	37,935,604	7,790,527	347,394,493	0	91,298,666	71,997,105	172,911,420	11,187,302	0	0	0	88,151	15,192	2,976	16	106,335	159
46,700	267,395,139	267,395,139	0		1,116,389	14,280	7,740,038	17,955,000	240,569,432	44,882	182,292	129,355	240,171,876	41,027	0	0	107	305	121	18	4	555	160
43,865	247,781,330	220,645,980	27,135,350		0	1,179,720	37,440,450	75,582,360	133,578,800	720,240	16,389,020	y 8,596,920	z 84,286,520	2,994,500	0	Q 20,591,600	1,366	20,485	4,405	567	113	26,936	161
45,000	245,268,100	245,268,100	0		0	0	0	245,268,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162
67,255	219,096,554	219,096,554	0		0	0	10,279,424	0	208,817,130	0	(c)	c 662,077	162,378,486	47,330	0	45,729,237	0	(c)	c 1,698	13	14	1,725	163
53,000	129,839,088	126,312,410	3,526,678		0	515,000	21,091,716	84,843,590	23,388,782	271,228	3,689,022	6,842,094	11,393,292	1,193,146	0	0	295	8,234	4,960	13	102	13,604	164
630,333	29,529,863,304	24,400,405,193	5,129,458,111		91,349,111	35,525,794	1,204,530,469	4,191,124,326	15,531,023,036	6,476,209	625,982,046	510,121,357	10,573,033,828	58,260,105	160,238,163	3,596,911,328	14,978	502,125	105,829	5,898	685	629,515	
207,000	1,161,261,933	1,159,970,985	1,290,948		0	14,599,853	473,469,748	0	673,192,332	E 1,562,860	70,982,352	35,515,370	3,754,380	13,178,525	77,667,358	470,531,487	129	167,496	48,912	28	9,966	226,531	165
7,000	6,502,175,000	6,459,914,000	42,261,000		0	(v)	v 841,669,000	654,466,000	5,006,040,000	0	0	0	0	0	0	0	0	0	0	0	0	0	38a
22,315	726,324,398	405,331,970	320,992,428		3,697,762	5,544,032	113,590,320	61,315,216	542,177,068	0	0	0	0	0	0	0	0	0	0	0	0	0	25a
0	308,571,614	308,559,917	11,697		0	5,841,524	63,722,023	1,290,705	237,717,362	0	94,628,717	50,774,510	57,693,624	20,543,909	14,073,000	3,602	0	131,761	18,370	4,848	96	155,075	28a
114,000	312,662,798	312,441,798	221,000		1,134,395	1,073,172	47,383,473	25,996,421	237,075,337	0	48,522,830	38,970,718	142,442,843	7,138,946	0	0	0	30,623	5,068	82	14	35,789	139a
0	1,090,188,836	1,090,092,580	96,256																				
0	G 840,211,953	262,754,235	G 577,457,718																				
0	658,056,629	0	658,056,629																				
0	605,556,117	605,379,805	176,312																				
0	375,134,980	0	375,134,980																				
0	318,748,423	0	318,748,423																				
0	240,715,739	0	240,715,739																				
0	223,998,060	219,630,060	4,368,000																				
0	180,201,900	86,385,500	93,816,400																				
0	146,218,748	0	146,218,748																				
0	138,922,560	0	138,922,560																				
0	137,715,998	98,910,454	38,805,544																				
16,000	128,618,335	92,785,660	B 35,832,675																				
0	116,990,371	0	116,990,371																				
0	99,650,100	99,650,100	0																				
16,000	5,300,928,749	2,555,588,394	2,745,340,355																				

SUMMARY OF GENERATOR RATING AND OUTPUT OF LARGE UTILITY SYSTEMS

Region	No. Cos. or Systems	Number of Generating Plants and Generator Rating — All Plants No.	All Plants Rating, Kw.	Fuel Plants No.	Fuel Plants Rating, Kw.	Hydro Plants No.	Hydro Plants Rating, Kw.	Output Gen. and Purch., Kw.-Hr.	Energy Generated (Net) Kw.-Hr.	Rec'd by Purch. or Interchange Kw.-Hr.
United States	**146**	**1,761**	**31,673,885**	**866**	**22,159,983**	**895**	**9,513,902**	**122,164,821,065**	**108,530,367,986**	**13,634,453,079**
New England	15	177	2,322,473	45	1,586,787	132	735,686	8,092,971,297	6,831,721,444	1,261,249,853
Middle Atlantic	22	315	8,893,978	128	7,060,441	187	1,833,537	34,318,709,232	31,094,663,105	3,224,046,127
East North Central	28	314	7,559,817	148	7,067,369	166	492,448	29,657,272,116	27,656,049,495	2,001,222,621
West North Central	15	228	2,206,587	149	1,655,490	79	551,097	7,334,003,055	7,090,345,751	243,657,304
South Atlantic (g)	14	151	1,942,639	94	1,210,680	57	731,959	7,895,104,616	5,592,157,448	2,302,947,168
East South Central	10	110	1,607,568	84	600,356	26	1,007,212	5,774,301,655	4,753,844,907	1,020,456,748
West South Central	16	174	1,464,159	160	1,381,908	14	82,251	6,562,175,519	5,785,350,627	776,824,892
Mountain	7	95	1,217,739	20	161,467	75	1,056,272	5,348,610,726	4,406,477,817	942,132,909
Pacific	19	197	4,458,925	38	1,435,485	159	3,023,440	17,181,672,849	15,319,757,392	1,861,915,457
Canada (g)	18	**152**	**4,728,407**	**14**	**98,074**	**138**	**4,630,333**	**29,529,863,304**	**24,400,405,193**	**5,129,458,111**
Mexico	1	**16**	**237,000**	**1**	**30,000**	**15**	**207,000**	**1,161,261,933**	**1,159,970,985**	**1,290,948**
Railways and Railroads	15	**18**	**1,087,255**	**16**	**1,071,255**	**2**	**16,000**	**5,300,928,749**	**2,555,588,394**	**2,745,340,355**

A Preliminary figures, subject to revision.

B Output of leased plants.

C Line 128 — Company construction uses.

D Line 44 — Comprising Milw. E. R. & L. Co., Wis. E. P. Co., Wis. G. & E. Co., Wis. Mich. P. Co. 25 — Incl. Litchfield E. L. & P., Greenville El. Co. and former Empire G. & E., N. Y. Central El. Corp. Elmira H. L. & P. Corp., 38 — Incl. Comm. Edison, P. S. of No. Ill., Western United G. & E., Ill. Northern Util., Super-Power Co. of Ill., Chicago Dist. Gen. Corp.

E Line 165 — Irrigation only.

G Purch. LIRR 48,241,600
PRR 529,216,118
Total LIRR 180,794,930
PRR 659,417,023

H No-charge energy, entered in this column for convenience

I Railway depts. of elec. cos. and affil. cos.

J Line 138 — 16,647,407 incl. in sales. 158 — Incl. in sales.

K Incl. affil. gas, water, bus cos., etc.

L Line 42 — Also 13,400 in plants whose entire output is contracted for. 129 — Incl. one leased int. comb. plant 24,250. 178 — Leased. hydro.

M Line 137 — Col. 6 incl. Boulder Dam unit. Col. 9 incl. 26,040,000 kw.-hr. Owens River Gorge plants.

N Incl. com'l rural 3,639,840 kw.-hr., 1,620 cust.; general or small power 10,184,209 kw.-hr., 2,318 cust.

O Gross.

P Cols. 15–21 combined; also Cols. 22–26.

Q Electric boilers.

T Line 158 — Standby. 70 — Also 250 int. comb. standby. 75 — incl. only plants oper. continuously or for standby in 1937. 90 — actual cap. limited by boilers to 12,500.

U Off-peak.

V 1,605 customers included in Com'l retail.

W Includes Winnipeg Selkirk & L. Winnipeg Ry., Suburban R. T. Co.

X Kv.-a.

Y Mainland system only.

Z Horsepower.

ELECTRICAL WORLD

MAY 7, 1938

Money for New Construction

Statements have been made from time to time by economists, government officials and even utility people that the electric light and power utilities had a construction backlog of between two and three billions. It was intimated, and in some cases positively stated, that this huge construction program would be released as soon as money was available. Newspapers, columnists, editorial writers all over the country took up this statement, quoting one leading economist to the effect that a release of this electric utility spending was all that was needed to break the current business recession. It was stated over and over that the money could not be secured until the government had stopped its act of sabotage against the utilities. Thus was the Administration held responsible for the prolongation of the business decline. The answer to this attack has come in the announcement that any utility that cannot secure money for new construction can borrow funds for that purpose from RFC.

Politically, all of these moves may have been fine strategy at the time, but they do not bring the true situation to light, nor do they solve the basic problem. And all the time this jockeying for position continues the investing public is hearing more and more about why it is not safe to put money in utilities.

Basically, the facts are these. The electric utilities do not have a construction backlog of close to three billion dollars. And if they did have and if they had the money to finance a construction program of that magnitude the manufacturers of electrical equipment could not turn out the orders.

There is a construction backlog, of course, but it is nowhere near as large as some people imagine. The backlog for the most part comes in lessened capacity reserve in plant and system. But it must be remembered that in the last few years the industry has demonstrated that reserve need not be of the same magnitude as was once thought necessary. This was fortunate indeed, for it brought with it increased use of investment and, therefore, better financial stability.

The industry has spent money as needed. It has not found it necessary to refuse load because capacity was not available. There may be some properties that will find themselves in trouble if load goes to new peaks because they are now in financial hot water. But by and large the utilities will continue to keep ahead of the load.

Again generally speaking, there will be no trouble getting the money for these undertakings, but there is a question as to what kind of dollars can be had. New money can be borrowed, and for the most part at reasonably low yields. Such financing, however, merely adds to the fixed charges, piling up trouble against the day when net income, due to another prolonged depression, will be insufficient to meet debt service. It is equity money that is wanted, and that is not easy to get so long as the policy of the Administration toward utilities is not unequivocally defined.

So, in spite of the fine gesture by the Administration, the utilities as a whole can hardly be expected to apply for any large amount of RFC money. The real spending power of the utility industry can be encouraged best by a straightforward statement of policy toward the industry that can be interpreted in only one way—a policy that will build confidence in the integrity of utility equity investment.

In spite of all that has happened in the past five years, the utility industry is still strong financially. For that reason it can borrow all of its construction requirements at favorable rates from regular channels without having to seek RFC loans and their attendant limitation upon company operations. New commitments for construction are low now, not because of inability to finance, but because of load conditions. When load picks up construction will pick up. Against the time when new peaks will require a large expansion and rebuilding program, necessitating the raising of large amounts of new capital, we should begin to emphasize the strength of the industry's financial organization and not its weaknesses.

26th Annual Survey of Large Systems

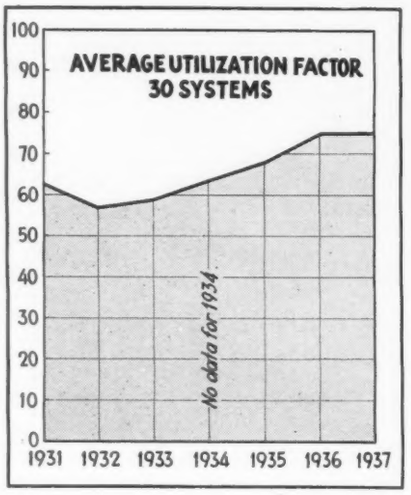
Capacity – Peaks – Output

Supplement Gives Details for 180 Systems in the 100,000,000-Kw.-Hr. and Over Class — Peaks Range From 39 to 129% of Rating — Load Factors Increased in 1937

By G. F. WITTIG
Statistical Editor

WHAT is the margin of capacity available at times of peak load? The answer to that question has become increasingly important, not only to the electric utilities but to the country at large, which depends on them for a service so essential that its curtailment or interruption would be disastrous.

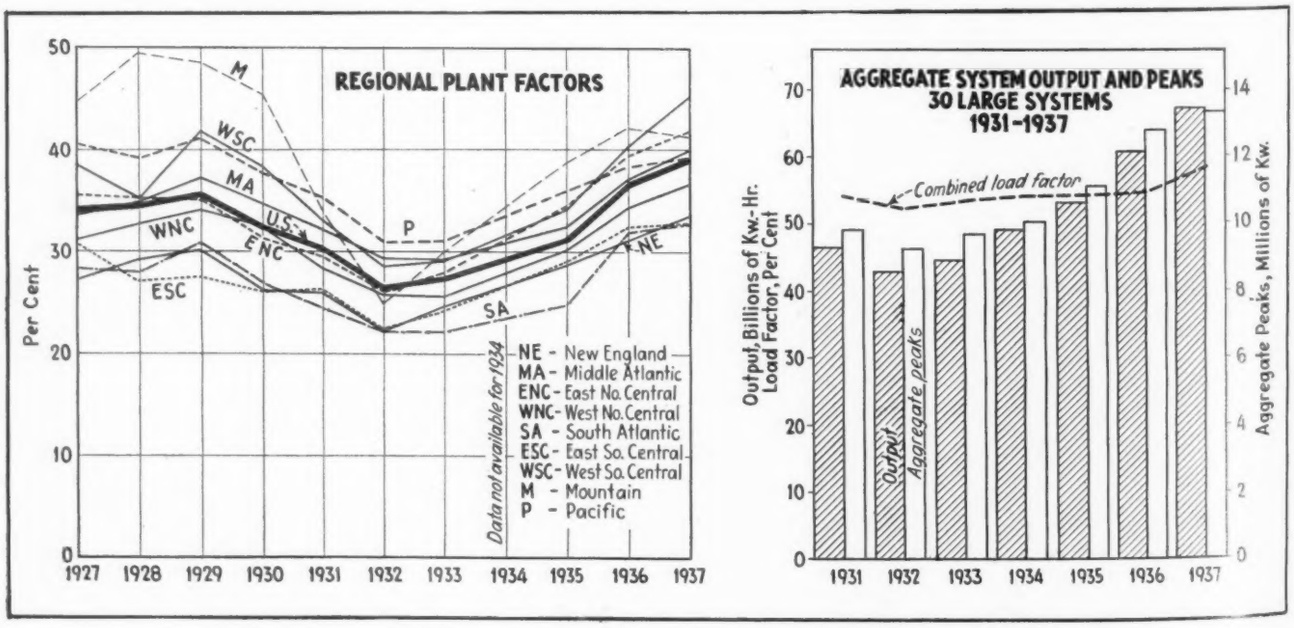
Data on this subject will be found in the annual supplement accompanying this issue of ELECTRICAL WORLD giving detailed data on the operations of 180 utility systems in the United States, Canada and Mexico, having an output of more than 100,000,000 kw.-hr. during 1937. Of these, 146 supply electric service in the United States. Barring one for which data were fragmentary, they account for 31,673,885 kw. of installed capacity, or about 91 per cent of the entire industry. Table I traces the system and the generator-station peaks and the total output over a series of years. Table II gives details for 1937 on station capacity, allocation of energy and number of customers.



Growing peaks during recovery restored fuller use of capacity built up in earlier years

For these systems the utilization factors (ratio of peak to capacity) are here presented in chart form. Omissions, reducing the number to 125, are due to missing data or to operations mainly on purchased energy which would make figures on utilization factor meaningless or perhaps misleading. Those charted represent 26,880,775 kw. or 77 per cent of the total capacity of the industry, including small companies not listed in this survey. No effort was made to determine what capacity may not have been available due to low water, overhauling, repairs or other causes.

Referring to the chart, generator



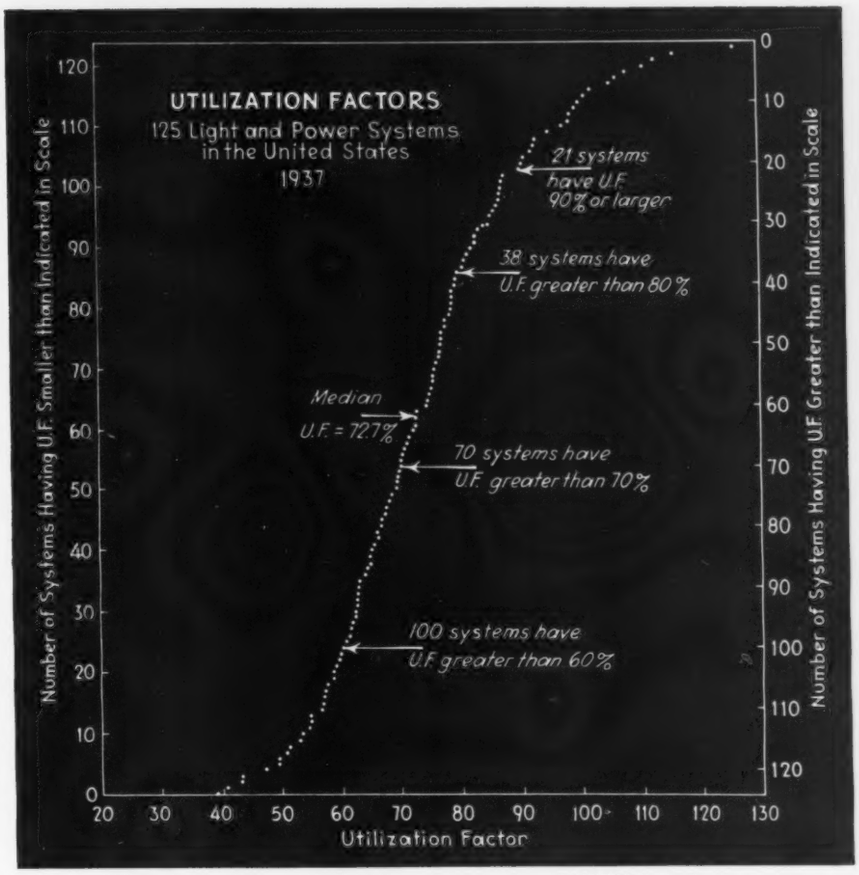
National output per kilowatt at new high, but year-end slump reduced system peaks compared with year's total production

peaks rising to 80 per cent of capacity or higher were recorded on 38 systems, having an aggregate capacity of 4,095,778 kw., or 15.2 per cent of the total for the group. On the other hand, 25 systems, with 3,261,732 kw., or 12.1 per cent of the total, had peaks that were less than 60 per cent. The remaining 62, or half the total number, but representing nearly three-fourths of the installed capacity, had utilization factors ranging between 60 and 80 per cent. The median for all companies was 72.7 per cent. Of those reporting 80 per cent or higher, half the capacity is in the Southwest and West, although these regions comprise only 22.5 per cent of the total for the entire country listed in the Supplement.

Base plants well loaded

Ten overshot 100 per cent. This does not necessarily imply serious overloading or the need of additional equipment. The power factor of the load may be higher than that corresponding to the kilowatt rating. The reactive component may be supplied near the load center, while the distant stations supply most of the energy. Most of the very high utilization factors were reported by hydro-electric systems, six of them in the Pacific states, and two of these were in irrigation districts. Interconnections, too, enter into the picture.

No broad generalization can be made for the country as a whole. For each individual system the attendant circumstances must be taken into account. While a considerable number of these seem to have equipment capable of meeting peaks well in excess of those recorded in 1937, there is another large group—perhaps a third of the total number—that must have more capacity when the demand again increases at a normal rate.


UTILIZATION FACTORS
125 Light and Power Systems in the United States
1937
21 systems have U.F. 90% or larger
38 systems have U.F. greater than 80%
Median U.F. = 72.7%
70 systems have U.F. greater than 70%
100 systems have U.F. greater than 60%
Number of Systems Having U.F. Smaller than Indicated in Scale
Number of Systems Having U.F. Greater than Indicated in Scale
Utilization Factor
0 10 20 30 40 50 60 70 80 90 100 110 120
120 110 100 90 80 70 60 50 40 30 20 10 0
20 30 40 50 60 70 80 90 100 110 120 130

Half the systems have peaks ranging between 60 and 80 per cent of installed rating

Moreover, it should be noted that the peaks were not as high in proportion to output in 1937 as in other recent years. Had they been 5 per cent higher on the average, the number of systems using 80 per cent of installed capacity would have been around 50 instead of 38.

To determine the trend, utilization factors were computed for 30 leading systems that could be traced through the period 1931 to 1937. Generator peaks were not reported prior to 1931. The average shows a definite increase from 63 per cent in 1931 to 76 per cent in 1936, with a sag in 1932 and 1933.

Despite the depression in the latter part of 1937 and the disproportionately small rise in peaks, added capacity in these 30 companies sufficed only to maintain the 1936 ratio of 76 per cent utilization factor. For a few companies figures were

Table III—Output, Aggregate Peaks and Group Load Factors, 30 Companies—1931-1937

Year	System Output Millions of Kw.-Hr.	Aggregate Peaks, Thousands of Kw.	Combined Load Factor, Per Cent
1931	46,989	9,870	54.3
1932	43,036	9,378	52.3
1933	45,435	9,714	53.3
1934	48,785	10,181	54.7
1935	53,019	11,120	54.3
1936	61,371	12,788	54.8
1937	67,089	13,256	57.8

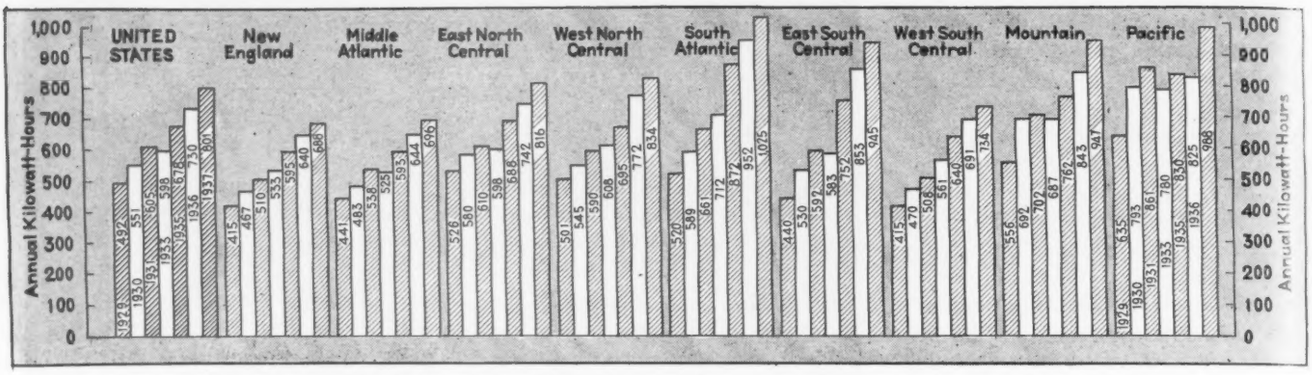
Table IV—Changes in Regional Plant Factors 1927-1937

Generated Kw.-Hr. ÷ (Plant Kw. × 8,760) Expressed in per Cent

Region	1937	1936	1935	1933	1932	1931	1939	1929	1928	1927
New England	33.6	31.2	28.7	24.7	22.4	26.0	26.3	30.1	29.2	27.2
Middle Atlantic	39.9	37.2	32.6	29.3	29.4	32.3	34.7	37.3	35.0	33.7
E. North Central	41.8	39.7	34.7	28.0	26.1	29.6	31.5	35.1	35.3	35.7
W. North Central	36.7	34.5	30.2	25.7	25.9	28.6	32.7	34.1	32.8	31.1
South Atlantic (a)	32.9	32.0	24.9	22.2	22.4	24.6	27.0	30.9	28.1	28.5
E. South Central	33.8	32.5	28.8	24.2	22.5	26.3	26.1	27.6	27.1	31.2
W. South Central	45.2	40.3	34.1	29.1	28.6	33.2	38.6	41.9	35.2	38.5
Mountain	41.4	42.2*	38.8	29.9	24.9	34.1	45.5	48.6	49.6	44.6
Pacific	39.3	38.5	36.0	31.1	31.0	35.5	37.8	41.1	39.2	40.6
United States	39.1	37.0	32.5	27.6	26.6	30.3	32.7	35.9	34.3	34.1
Canada (a)	59.0	57.2	53.2	43.4	42.7	44.4	51.1	61.7	55.2	57.2

* Omitting Boulder Dam, not operated full year.

(a) Omitting Duke Power and Hydro-Electric Power Com. of Ontario, for which detailed data are not available.



Average consumption per domestic customer of major systems now 63 per cent over 1929, every region gaining

not available for some of the earlier years, and the comparisons are therefore only approximate, but the trend is unmistakable.

More kilowatt-hours per kilowatt

More kilowatt-hours were generated per kilowatt of capacity in this representative group of systems during 1937 than in any one of the past ten years, and probably more than at any previous time in the history of the industry. This is evident from the table of plant factors, which expresses the ratio (in per cent) of average load to station capacity. For the United States as a whole this plant factor rose to 39.1 per cent in 1937, against the previous maximum of 35.9 per cent. This is an increase of 9 per cent.

Plant factors are higher now in every region except the Mountain and Pacific. The former is greatly affected by activity in metal mining, which during the decade has varied between wide limits. Both western regions show the effect of the coming of power from Boulder Dam. In the Mountain states this lowered the utilization factor in 1937 to 41.4 per cent. Omitting the capacity and output of Boulder Dam, it would have been 43.7 per cent. In the Pacific states, where most of this energy was consumed, it tended to reduce the use of installed generator capacity and thus to lower the plant factor.

The effect of 24-hour loads is strikingly evidenced in the figures for Canada, where much energy is used in the pulp and paper industry, and where electric boilers furnish an outlet for secondary power. Outputs approaching, and in one year exceeding, 60 per cent of the ideal maximum are recorded for that country as a whole. This is higher than the ratio in any one of the nine geographical regions of the United States.

Low peaks in 1937

Discussion thus far has related to generator peaks, output and capacity. While the last of these items can be controlled by the installation—much less readily by the elimination—of station capacity, the two others are determined by the characteristics and magnitude of the load; that is, system output, including purchased energy, and system peaks.

These were analyzed for the 30 largest systems that could be traced,

[*Continued on page 111*]

Table V—Allocation of Output of Major Light and Power Systems, 1929 to 1937*

Class of Service	146 Systems in 1937			148 Systems in 1936			140 Systems in 1935			144 Systems in 1932			137 Systems in 1929		
	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales
Farm or rural†	1,824	1.5	2.1	1,574	1.4	2.0	1,300	1.3	1.9	} 9,814	11.3	17.0	7,561	8.0	11.3
Domestic†	14,405	11.8	16.4	12,879	11.2	16.0	11,221	10.9	16.0						
Commercial retail	13,864	11.3	15.8	12,430	10.8	15.3	10,422	10.1	14.9	9,089	10.4	15.7	9,184	9.7	13.7
Commercial wholesale	48,819	40.0	55.5	44,307	38.6	54.9	38,885	37.8	55.7	29,993	34.6	51.8	41,752	44.1	62.5
Municipal	2,095	1.7	2.4	2,929	2.6	3.6	2,717	2.6	3.9	2,512	2.9	4.3	2,230	2.4	3.3
Other Sales†	1,227	1.0	1.4	721	0.6	0.9	296	0.3	0.4	1,231	1.4	2.1	971	1.0	1.5
Railways and railroads	5,684	4.7	6.4	5,912	5.2	7.3	5,008	4.9	7.2	5,234	6.0	9.1	5,149	5.4	7.7
Used by ultimate consumers	87,918	72.0	100.0	80,752	70.4	100.0	69,849	67.9	100.0	57,873	66.6	100.0	66,847	70.6	100.0
Other public utilities	16,606	13.6	.....	17,756	15.5	.....	17,832	17.3	.....	15,690	18.0	.....	13,290	14.0	.....
Affil. ry. depts.‡	574	0.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Used by companies	1,275	1.0	.....	1,177	1.0	.....	983	1.0	.....	953	1.1	.....	1,395	1.5	.....
Losses, etc	15,792	12.9	.....	15,063	13.1	.....	14,231	13.8	.....	12,397	14.3	.....	13,199	13.9	.....
Total gen. & purch.	122,165	100.0	.....	114,748	100.0	.....	102,895	100.0	.....	86,913	100.0	.....	94,731	100.0	.....
Company use plus losses in per cent of generated	.....	15.7	.....	.....	16.5	.....	.....	17.5	.....	.....	18.7	.....	.....	17.9	.....

* For 1930, 1931 and 1933 see ELECTRICAL WORLD, May 5, 1934.

† For 1933 farm or rural data where separately reported were combined with domestic. In prior years they were variously included in the reports with domestic, with " other sales " or, especially in the West, with " wholesale." ‡ Included in railways and railroads prior to 1937.

Electric Water Systems Pave Way for Rural Load

Added Usage Is Three Times That Obtained From Pump —Dealers, Manufacturers and Utility Combine for Sales and Promotion

By R. W. CLARK

Merchandise Manager Puget Sound Power & Light Company, Seattle, Wash.

THE Puget Sound Power & Light Company operates in nineteen counties of western and central Washington. More than 90 per cent of the homes and farms in the suburban and rural areas have electric service available and most of them use electricity. For a number of years the company has aggressively developed rural electrification, with the result that there are about 75,000 domestic and farm customers outside of incorporated towns and cities on its lines. About 60 per cent of these customers are suburban residents, the remaining 40 per cent, some 30,000 in number, can be classified as farmers.

It is estimated that approximately 25,000 of the 75,000 rural customers have in use and own electric pumping units with pressure water systems purchased over a period of years. The remainder, or about 50,000, either are served from established towns and district water systems or pump it from wells or dip it from streams and pools. It is the general assumption that perhaps 25,000 of these could be classified as reasonable present or future prospects for the sale of electric pumps and running water systems.

Running water—"necessity No. 1"

The company for several years has followed the plan of confining its direct merchandising policy to the sale of electric ranges, water heaters and refrigerators. A broad and sustained program of dealer co-operation has been extensively used to promote the sale of all other items of electrical equipment.

Among the several classes of promotional programs, we have considered none more important than the market for electric water systems. Running water is listed as "necessity No. 1" and the sale of pumps occupies a position in the forefront of the list of businesses that share substantially in our promotional attention. While incidental development work had been fostered in this connection for several years past, a more intensive program was begun in 1935. At this time we definitely tied in with the activity of the Electric Water Systems Council sponsored by the manufacturers and the Edison Electric Institute and have followed up consistently since.

To carry on a more thorough development in the first year, a series of dinner sales meetings were held in different parts of our territory, at which pump manufacturers' representatives and utility men gathered and outlined a uniform program. At these meetings short special talks were given by several pump distributors on assigned subjects such as: "Where to Sell," "How to Sell" and "Methods of Financing Electric Pump and Water System Installations." Talks on practical irrigation and running water applications, together with the relation of the power company to the pump distributors and dealers, were included.

Plans were developed and carried out for holding a dealer window display contest. Two sets of four cash prizes, totaling $100, were offered for the best window displays in both the northern and southern areas of the company. The windows were adjudged upon their attention-attracting value, the amount of interest aroused, the creation of desire for merchandise such as displayed and sales contact value. There were so many entries that it was necessary for the judges to drive some nine hundred miles in making appraisals for the awards. Dealers reported many sales as a re-

R. W. Clark

Manufacturers, distributors, dealers and utility co-operate in outdoor demonstrations of electric water systems

sult and each dealer's store in addition obtained from fifteen to one hundred live prospects for future sales efforts during the follow-up months.

In the following year, 1936, a series of running water demonstrations was put on by the distributors, dealers and the power company, in co-operation, at ten strategic centers over the company's system.

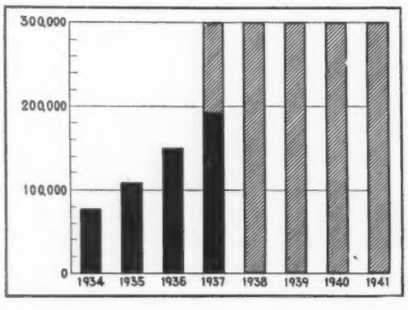
For 1937 dealer meetings and pump demonstrations were combined with effective results. A schedule of ten demonstrations was planned early in the year for a period between April 1 and June 15. The schedule was so formulated that sufficient time was allowed for manufacturers to travel from one demonstration point to another and set up their equipment. At three of the centralized points over the territory dinner sales meetings were held on the evening following the show. Many of the dealers attended from some distance; they brought with them in many cases their prospects.

Notices and invitations to the sales dinners were prepared by the Puget Sound Power & Light Company and sent to the dealers by their distributors, who stood the expense in connection with the tickets. Attendance prizes were furnished for dealers only, by the pump distributors at each meeting. These prizes consisted of such items as I.E.S. lamps, small electrical appliances, pipe cutters, Stillson wrenches, well points, stock and die or other desirable articles useful to the pump dealer's work. They were given away at a drawing held at the close of each meeting. The program of each session covered a diversity of subjects pertinent to the industry; the power company presented the talking picture called "Life in the Country," which was purchased through the National Electric Water Systems Council.

Outdoor pumping exhibitions

The pumping demonstrations proved to be effective sales programs. Locations chosen were adjacent to highways and were thus convenient to those who came from a distance. Many passing automobilists were attracted by the group meetings and stopped to investigate what was going on.

The water for the demonstrations was drawn from some irrigation ditch, stream or other water supply which was convenient to electric power lines. Care was taken to select a site that was favorable and which was well known as to location and could be identified in the advertising. Weather, of course, was a factor in the attendance of a meeting of this kind. Bad weather definitely limits attendance and often too good weather has a similar effect, because the farmers want to stay home and take advantage of it in doing necessary work.



Sales of electric water systems reported by Electric Water Systems Council of the Edison Electric Institute, H. E. Dexter, chairman

Goal for the five years 1937–1941 inclusive is shown cross-hatched, and amounts to a total of 1,500,000 electric water systems.

The Puget Sound Power & Light Company carried ads in the local newspapers regarding the demonstrations and announcements were made over the radio. The company's farm representatives worked intensively with the farmers of their particular district and handed out personal invitations to those whom they thought interested. In several cases the county agricultural agents sent out notices to the farmers in their territory. Dealers were provided with window trim material and were encouraged to advertise the display among their own customers. They brought many of their prospects to look over the equipment in operation.

About a dozen manufacturers and distributors have taken part in these demonstrations. The shows have included a complete exhibit of irrigation and domestic water supply systems, and sprinkler systems installed and operating have illustrated the rain maker and other methods of putting water on the land by means of electric pumping. The installation of wiring for the shows was turned over to a single firm, which visited the selected fields in advance and laid cables with junction boxes at intervals into which the equipment to be demonstrated could be plugged. The cost to the power company was nominal and resulted in an orderly installation, much in contrast to the usual haphazard arrangements for temporary service.

Attendance, while generally good, varied somewhat. For instance, at the Whatcom County show, held at Lynden, cold winter weather had its effect, yet some 225 farmers attended. Many of them brought their wives and families along. The interest of those who did attend was genuine; often they spent several hours going over the equipment and asking questions, for which definite and practical answers were always available.

At each of these shows a prize drawing was held late in the afternoon. The prizes were composed of such items as a 25 per cent credit on the purchase of a Monel tank, automatic electric water heater, or a 25

[*Continued on page 113*]

First Hydrogen-Cooled Generator in Service

Operated With Substantially Lowered Temperatures and About 17 per Cent Less Steam Input at No-Load

FIRST of the hydrogen-cooled generators to go into service is the new 25,000-kw., 3,600-r.p.m. General Electric Company turbo-generator at Millers Ford station of the Dayton Power & Light Company at Dayton, Ohio. This machine was put in operation with hydrogen cooling on October 12, 1937. The advantages of hydrogen cooling over air cooling may be given briefly as follows:

1. As hydrogen is much lighter than air, the windage, friction and ventilating losses are reduced to about 10 per cent of the loss which exists when air is used.
2. Due to the absence of oxygen and moisture in the windings, increased life of insulation may be expected.
3. No special fire protective equipment is needed, since fires cannot occur due to the absence of oxygen.
4. With the better heat transfer and lower losses with hydrogen, the gas coolers are smaller and less cooling water is needed, consequently the machine and its cooling system is of smaller, more compact design.
5. Noise is reduced because of lower density of hydrogen as compared with air.
6. The foundation design is simplified and all external duct work is eliminated.

These advantages led to the deci-

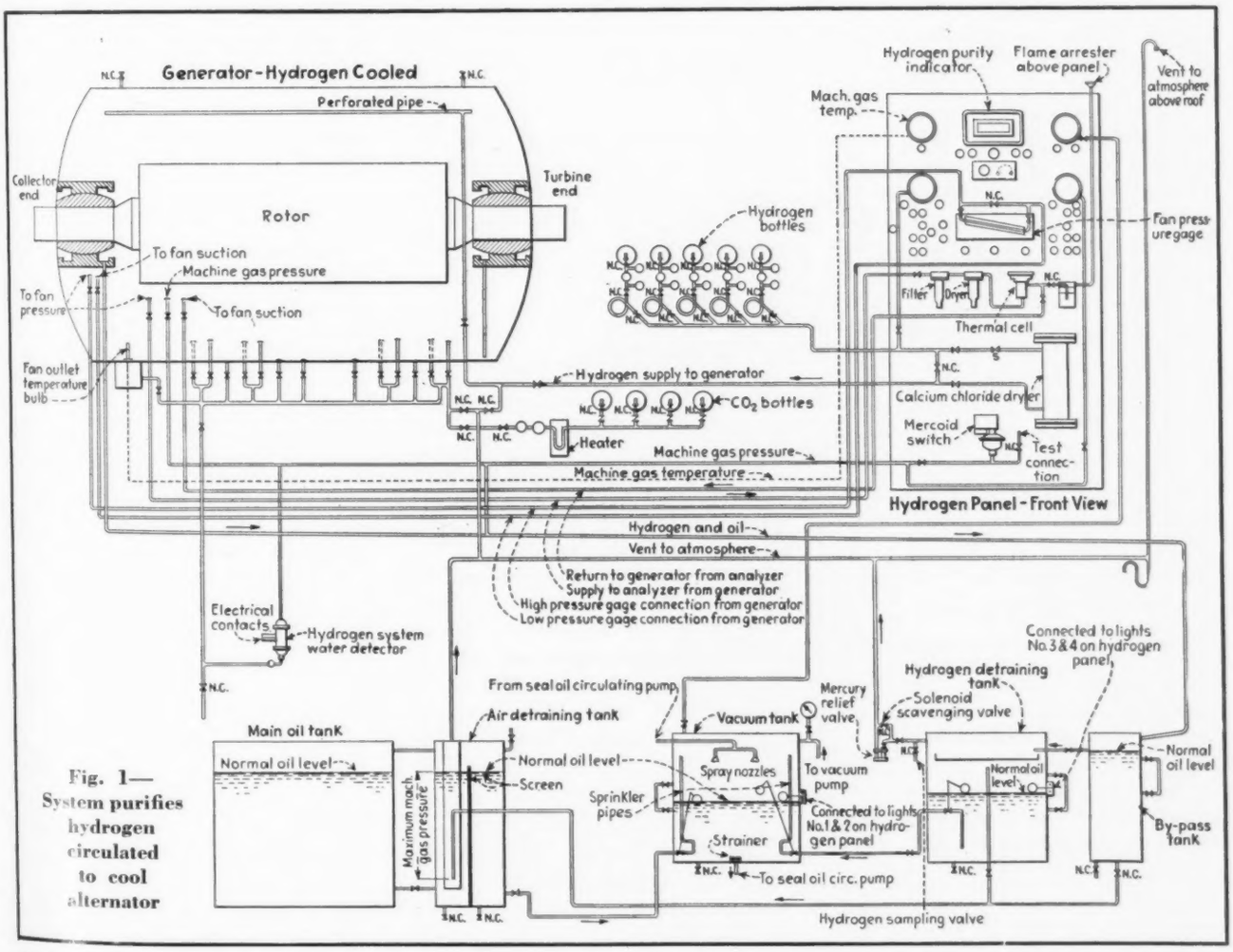


Fig. 1—System purifies hydrogen circulated to cool alternator

Signal lights on panel indicate whether the following operating conditions are normal or abnormal: (1) Oil level in vacuum tank. (2) Oil level in hydrogen detraining tank. (3) Failure of seal-oil circulating pump (see Fig. 2). (4) Low bearing oil pressure. (5) Low vacuum in vacuum tank. (6) High machine gas temperature. (7) Hydrogen bottle pressure. (8) Machine gas pressure. (9) Fire in oil room. (10) Failure of main oil pump. (11) Seal oil pressure. (12) Water in hydrogen.

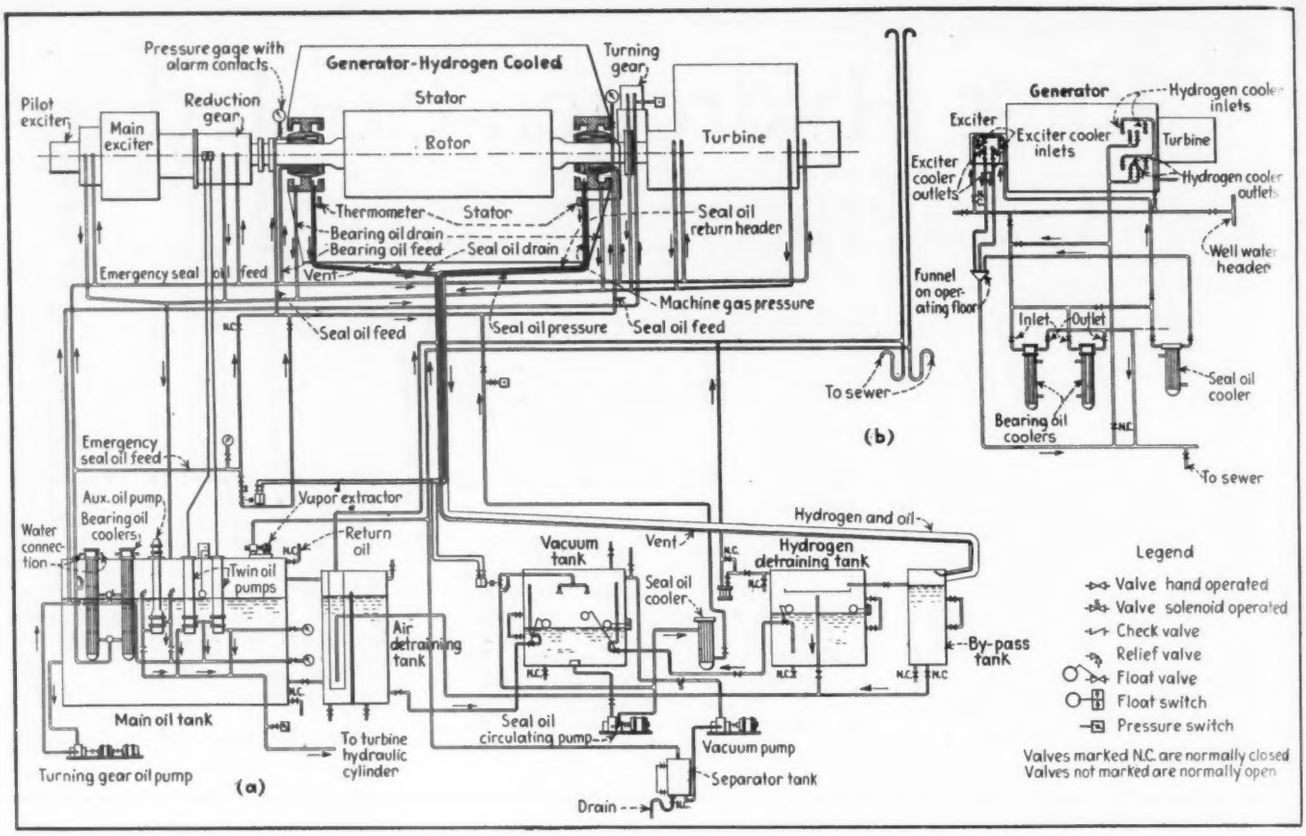


Fig. 2—Oil for bearings and seals circulated in system interlinked with hydrogen system of Fig. 1
(a) Seal oil and bearing oil connections. (b) Water connections to coolers.

sion to apply hydrogen cooling to the new Millers Ford unit. The gas is circulated through the machine by fans on each end of the rotor. The heat absorbed by the gas in passing through the core and windings is removed by four gas coolers of the fin-tube type which are located within the machine casing.

The machine is designed to circulate 35,000 cu.ft. of hydrogen per minute through the coolers at rated r.p.m. It was calculated that the coolers would require 200 g.p.m. of cooling water at rated load with an inlet temperature of 70 deg. F. Tests are to be made in the near future to check these rates of flow.

Hydrogen purity easily maintained

The purity of the hydrogen in the generator should not be less than 90 per cent in order to prevent the possibility of obtaining an explosive mixture. No difficulty has been experienced in maintaining a purity of 97.5 per cent at all times. The hydrogen pressure is kept above atmospheric pressure to prevent air leakage into the generator casing. Escape of hydrogen from the generator casing at the points where the shaft passes through the end shields is restricted by a shaft seal of the oil-film type in each generator bearing.

Vacuum-treated oil is supplied to the seals and this oil divides, with about 45 per cent going to the gas side and 55 per cent going to the air side of the seal. Therefore, the oil to the gas side of the seal will pick up hydrogen and the oil to the air side of the seal will pick up air.

Detraining tank operation

Hydrogen-impregnated oil from the seals is passed into the hydrogen detraining tank, where the larger bubbles of hydrogen entrained in the oil are separated out and allowed to return to the generator. The air-impregnated oil from the seals returns with the bearing oil to the main oil tank, whence an equal amount flows to the air-detraining tank, where the larger bubbles of air entrained in the oil are given up. Oil from the air-detraining tank and the hydrogen-detraining tank flows by suction to the vacuum tank. A rotary vacuum pump maintains a vacuum of 0.5 in. of mercury absolute in this tank, which removes practically all of the air and hydrogen remaining in the oil. By thus removing practically all the air and hydrogen from the seal oil complete safety of operation is insured.

Emergency oil seal provided

To provide an uninterrupted supply of oil to the seals, in case of failure of any part of the oil-treating system, an emergency seal oil supply is provided by which bearing oil may be supplied to the seals. When this occurs a small amount of air will leak into the casing through the seals and the generator must be scavenged with pure hydrogen in order to maintain the hydrogen purity in the generator.

Make-up for normal loss of hydrogen, by absorption in the shaft sealing oil and by leakage from the casing, is automatically controlled by a Mercoid pressure switch and a solenoid valve. The Mercoid switch is set to close contacts at about 8 in. of water and open contacts at about 12 in. of water. When, through loss of hydrogen, the machine gas pressure falls to the lower setting of the Mercoid switch, it operates to hold the solenoid valve open and admit hydrogen to the casing; when the machine gas pressure has risen to the upper setting of the Mercoid switch

[*Continued on page 115*]

Improved Wiring Methods Needed to Promote Adequacy

Lower Cost Methods Will Open Up Opportunity for Selling Rewiring in Older Buildings, Which Is Today's Largest Market for Electrical Construction Labor and Materials

By C. W. KELLOGG
President Edison Electric Institute

IT IS my purpose to outline briefly the programs of the electric utilities which have as their objective the provision of more adequate wiring. I wish later to point out also the relation of one of these programs, the one looking toward improved electric wiring, to the interests of others concerned with electrical installations. This latter program has given rise, it appears, to some misunderstanding as to the attitude of electric utilities toward the use of existing types of wiring and as to its relation to the National Adequate Wiring Program.

The pressing need for more adequate wiring—that is, more conductor capacity, more circuits and more outlets in dwellings, hotels, stores, offices or other buildings—is well recognized by all branches of the electric industry. This is evidenced by the recently adopted National Adequate Wiring Program sponsored by the National Electrical Manufacturers Association, in which all branches of the industry are participating. This program recognizes the fact that consumers of electricity, of whom there are 108,000,000 in this country, living in all classes of homes, in metropolitan cities and crossroads villages, in suburban areas and on isolated farmsteads, want ready access to the electricity that has been brought to their homes and places of employment.

Electric wiring installed in houses twenty to thirty years ago, with little or no change except the addition of temporary wiring extensions, is now carrying from three to five times as much electricity as when it was installed. This load may be expected to continue to increase at a substantial rate for many years, and, unless practical means are adopted to remedy the situation, there will be more voltage drop to handicap lighting and interfere with the operation of appliances, more trouble from overheated circuits, from blown-out fuses and bridging of fuses, more lamp cord wiring, more kilowatt-hour losses for the consumer, and more lost business opportunities because of the throttling effect of inadequate wiring.

The promotion of more and better interior wiring is not a new effort of the electric utilities. It has long received their serious attention and encouragement. Companies for years have striven to educate the building industry and building owners and prospective owners through advertising and direct selling in the advantages of ample wiring and an abundance of outlets. During the past several years, to aid public acceptance of electrical appliances, some companies have spent large sums of money in paying part or all of the cost of wiring installations. In a national way the electric utilities have joined with other branches of the industry in the preparation of adequate wiring manuals that have had wide circulation among builders, architects, etc., and they are participating with them in the National Adequate Wiring Program, to which reference was previously made.

Product investigations

In harmony with these efforts to promote adequate wiring, electric light and power companies for the past several years have been engaged in studies, investigations and trial installations aimed at finding new and improved wiring materials and better wiring methods to help solve the chronic inadequacy of circuit capacity and lack of outlets and to aid in overcoming the failure or unwillingness of the building owner or tenant to put more investment into electric wiring.

Notwithstanding the efforts the electric utilities have made to promote more wiring of the existing types, none of them have ever been able to make any progress worth mentioning in trying to add to the wiring facilities in the millions of existing homes in the country, yet these homes, where most of the people will continue to live for a long time to come, offer the biggest market for the sale of wiring jobs that will be available for years to come. Nor have the electric utilities in general been successful in overcoming the common practice in new building construction of trimming down on the number of wiring circuits in order to shave down the building cost. Long experience in trying to sell wiring convinces the electric utilities beyond question that to provide adequate wiring in the many classes of buildings and in the wide variety of locations in which its customers live and work there must be provided a greater price range for wiring installations.

The electrical manufacturer produces items of equipment and appliances of varying prices designed to do the same work but built to meet the "ability-to-pay" of several classes of purchasers. This same practice is true of the marketing policies of all other industries. A wide price range is offered. There

are millions of low-income buyers in this country. They want, for instance, to enjoy the benefits of automobile transportation and are thankful that there are Fords as well as Cadillacs. They want clothes for their wives and children and are thankful that outfits are offered to them at $7.95, of the same modern style as the $100 gowns in expensive shops. They enter a clothing store and can be shown a line of suits from $15 to $100 and upward.

Should electric wiring have but a limited price range for the consumer to "take it or leave it," and more often to leave it, resigning himself to an unfilled wish? Shall a barrier be allowed to remain in the wiring field to block access to a substantial field of business? No, business sense will surely prevail and electric wiring will follow the course of all other industry that has had vigorous and sound growth.

In striving for improvement in wiring materials and methods substantial progress has already been made. A number of new and improved types of wiring, wiring insulation and fittings are now on the market. Non-metallic sheathed cable is fully recognized in the Code and widely used, although in many instances backward city ordinances still prevent or hinder full enjoyment of the benefits of this type of wiring. Service-entrance cable has been recognized in the Code and has become widely available. The new covered neutral type of cable, commercially known as CNX, has been recognized for trial installations and its very substantial advantages are being realized in a growing number of areas. Conductors with thinner wall insulation are now manufactured commercially and are made use of in some types of wiring, particularly for renewing and supplementing the wiring in old buildings, but their general application for interior wiring has not yet been recognized even on a trial basis.

Proposals to improve wiring

Findings derived from wiring investigations and studies and from the progress to date in installing new wiring materials and methods have been summarized and crystallized into a definite list of proposals formulated by the Edison Electric Institute looking toward appropriate changes in the National Electrical Code. These proposals, which have already been submitted to the National Electrical Manufacturers Association with a request for comments and in due course are to be offered for inclusion in the National Electrical Code, are as follows:

1. Provision for the general use of non-metallic sheathed cable of the covered neutral type, as a wiring system.
2. Provision for the use of duplex and multiple-conductor cables of covered neutral type in raceways of all classes.
3. Provision for bare neutral in conduit and electrical metallic tubing for general use.
4. Provision for the general use of thin-wall insulation.
5. Modification of the conduit area rule to permit in old installations utilization of the waste space for additional wire required by increased loads.
6. Recognition of service cable of the covered neutral type for general indoor use.
7. Removal of requirement for mandatory use of rigid conduit in theaters, elevators and hazardous locations and of metal-clad wiring in garages.
8. Deletion of rule requiring conduit to be shipped in 10-ft. lengths.

The common objective of these proposals, some of which contemplate specific and substantial changes in present practices, is the much freer use of copper, more branch circuits and more outlets in interior wiring.

Covered neutral

The proposal for the general use of covered neutral wiring, known commercially as CNX, or by other trade designations, both alone as a wiring system and for use as a duplex conductor in raceways, would provide a compact cable containing both conductors of a two-wire circuit in little more than the space at present required for a single conductor. The advantage of such an assembly is obvious, both from the point of view of ease in handling and of economy of space in raceways. Moreover, this form of assembly, wherein the neutral and grounded conductor surrounds the live conductor, presents a very substantial advance from the point of view of safety and of overload control because it becomes practically impossible for the live conductor to become grounded without clearing the fault by the operation of a fuse or circuit breaker.

This form of assembly of conductors, when used alone as a wiring system, has an impressive record of efficiency and safety in a large number of trial installations. Not only is this true of covered neutral wiring but, as a matter of fact, there is available also a field history of another type of this same form of assembly with a metallic outside covering in direct electrical contact with the grounded neutral wire. This experiment, which comprises upward of a thousand installations in service for five or six years, has also been entirely successful.

Bare neutral in conduit

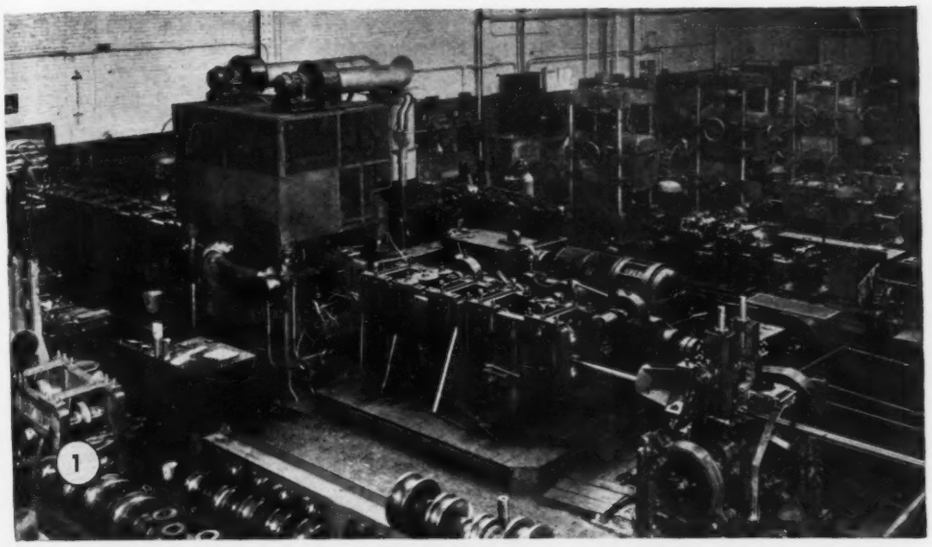
The provision for bare neutral in conduit and electrical metallic tubing would accomplish a substantial saving of space. By the use of a bare neutral the current-carrying capacity of existing installations can be increased 50 per cent or more, and by the use of a common bare neutral in the case of multiple circuits can be increased 100 per cent or more without increasing the conduit space occupied by the conductors. This proposal is of very great importance to hotels, office buildings and stores where the existing circuits, particularly those in risers, are now loaded to the limit, or overloaded, because of increased use of electricity. It provides a safe and practical means of increasing the current-carrying capacity of conduits and raceways without the inconvenience and disturbance of chopping into the walls and ceilings to place new conduit.

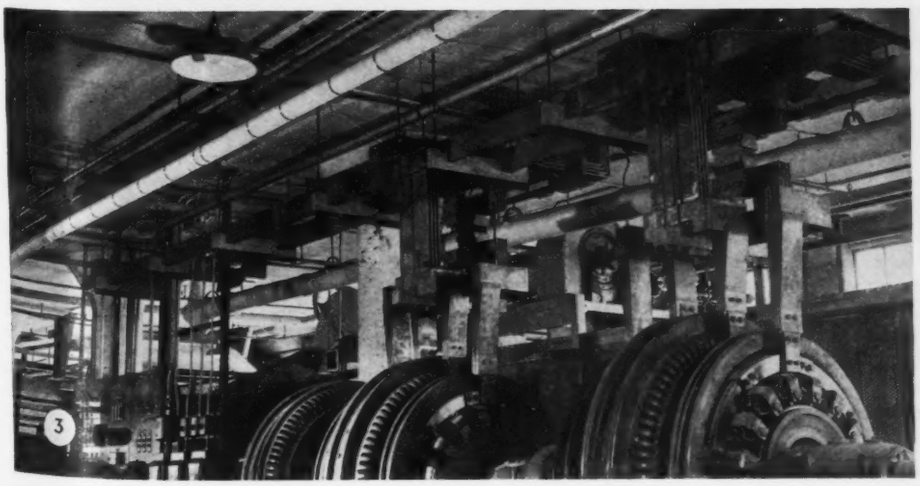
Aside from the question of cost, the reluctance of householders and of occupants of buildings to undergo the disruption and annoyance of cutting into walls, floors or ceilings is a powerful deterrent to wiring sales. Each time the question comes up the ordeal is postponed and the building occupants decide to forego a little longer the desired improvements. This deferment many times repeated has become a stalemate. A strong sales argument indeed is afforded when a hesitant building occupant can be assured of little or no disturbance during alterations.

In view of the concern that has often been expressed with reference to stray currents from bare neutral conductors, it is important to note that due to the inductive relations between the conductors of the circuit and a continuous magnetic envelope, which holds true in the case of conduit and electrical metallic tubing, the impedance of external circuits

[*Continued on page 116*]

Electrical Methods Yield an Electrical Product





NEWLY INSTALLED modern cleaning, electrogalvanizing, enameling and baking set-up at the Brooklyn plant of Steel & Tubes, Inc., doubles the possible output of light wall conduit.

1. Cold-rolled steel strip entering Johnston resistance tube welders is gradually changed in contour under a series of rolls until it reaches the operators' position as a tube. Butted edges are welded by the resistance method into a tube which is next straightened, cut to length, chamfered and made ready for galvanizing.

2. Sprocket wheels pass the 10-ft. lengths of tubing from tank to tank preparatory to delivering them to electroplating tank, where they receive galvanized coating under the action of 36,000 amp. at 6 volts. Micarta fingers in background guide tube throughout the plating solution along a copper bar a few inches above the zinc anodes. Copper bar makes tube the cathode of the circuit.

3. Synchronous motor-driven plating generators supply current for electrogalvanizing process over bus system containing 20 tons of copper. The new copper brazing technique that displaced bolting for fabricating bus was described in ELECTRICAL WORLD, November 6, 1938, page 64.

4. Tubes dried after leaving the galvanizing tank are sprayed on the inside with a coating of enamel and baked. Tubes here are passing through floor from drying furnace above to the enameling furnace. On emerging from enameling furnace they are given a final inspection and bundled for shipment.

Chart Compares Protective Devices Characteristics

By PAUL M. ROSS • • • H. L. RORDEN
Superintendent High-Voltage Laboratory *Development Engineer*
Ohio Brass Company, Mansfield, Ohio

INDIVIDUAL reference charts for various types of protective devices provide a convenient means of studying the characteristics of these devices separately, but it is difficult to use them for comparing characteristics of two or more devices. To facilitate such a comparison the accompanying chart has been prepared, on which pertinent values of three station protection devices are plotted—rod, gaps, control gaps and lightning arresters. These show basic impulse insulation levels, rod gap flashover characteristics, switching surge and lightning potential expectancies, control gap flashover characteristics, lightning stroke current expectancy and typical lightning arrester performance characteristics. On this one chart a means is provided for determining essential comparative values quickly and conveniently.

Two typical examples are given as a guide in using the station protection chart. The first of these involves the assumption of equal outages from an operating viewpoint for the rod gap and the control gap. The second involves the assumption of equal protection at a 1-microsecond level as provided by the three types of devices represented.

Example 1—Three-phase Solidly Grounded 69-Kv. System

Sequence—Start at A (Abscissa), Diagram 1

Along Line 1 to B—Three times line to neutral voltage—169-kv. crest. (Assumed permissible system outage level.)

Along lines 2 and 3—66-kv. switching surge potentials expectancy curve showing the approximate percentage of the total number of switching surges occurring on a system which may be expected to cause an outage by exceeding the assumed line-to-neutral voltage outage level; 22 per cent of switching surges expected to exceed 169-kv. crest. (Determined.)

From B, along lines 4 and 5 to C. Along line 6—The lowest flashover voltage obtained on a rod gap under operating conditions is the wet switching surge flashover voltage which has been found to be approximately equal to that of 60-cycle wet. A 14-in. rod gap has a 60-cycle wet flashover equal to the assumed three times line-to-neutral voltage permissible outage level of 169 kv. (Determined.)

Along line 7—The protective characteristic of the rod gap is determined by the voltage required to flash it over in any assumed flashover time. It is desirable to determine the protective characteristic of the rod gap at an assumed 1-microsecond flashover time. The 14-in. rod gap has a 1-microsecond flashover voltage of 425 kv.

Along lines 8 and 9 to D. Along line 10—The microsecond flashover protective level established by the protective gap should be *less* than the basic impulse insulation level for any system voltage. The 425-kv., 1-microsecond flashover of the 14-in. rod gap is 65 kv. higher than the 360-kv. basic impulse insulation level for the assumed 69-kv. system. (Determined.)

From D, along line 11—Lightning potentials expectancy curve showing the approximate percentage of direct strokes which would cause voltages on the stricken line conductor in excess of a chosen ordinate value. In the absence of a protective device, approximately 94 per cent of the direct strokes striking a station conductor would cause potentials in excess of 425 kv.

Along lines 12, 13 and 14—Lightning stroke current expectancy curve, showing approximate direct stroke currents expected to be exceeded by the chosen ordinate percentage. It may be expected that approximately 94 per cent of the direct strokes occurring at the station on line conductors will have currents in excess of 3,800 amp. (Determined.)

Along line 15—"Typical Performance of Modern Lightning Arresters," showing the expected *IZ* drop across the arresters for various discharge currents. These *IZ* potentials are impressed on the insulation to be protected. A 235-kv. potential will appear across the 60-kv. lightning arrester used on a 69-kv., solidly grounded three-phase system while discharging 3,800 amp. (Determined.)

From A (Diagram 1)

Along line 1 to B. Along lines 4 and 5 to C. Along line 16—The lowest voltages liable to flash over the control gap under operating conditions are wet switching surges. A 7½-in. gap spacing on a 46- to 69-kv. control gap provides a wet switching surge flashover of 169 kv., equal to three times line-to-neutral voltage on assumed 69-kv. system. (Determined.)

Along line 17 to E—The protective characteristic of the control gap is determined by the voltage required to flash it over in any assumed flashover time. It is desirable to determine the protective characteristic of the control gap at an assumed 1-microsecond flashover time. The 7½-in. control gap spacing has a 1-microsecond flashover voltage of 275 kv.

From E, along line 18 to F. Along line 19 to G. Along line 20—The 1-microsecond flashover protective level established by the protective gap should be *less* than the basic impulse insulating level for any system voltage. The 275-kv., 1-microsecond flashover of the control gap is *85 kv. lower* than the 360-kv. basic impulse insulation level on the assumed 69-kv. system. (Determined.)

From G, along line 21—In the absence of a protective device, approximately 96 per cent of the direct strokes striking station conductor would cause potentials in excess of 275 kv. (Determined.)

Along lines 22, 23 and 24—It may be expected that approximately 96 per cent of the direct strokes occurring at the station on line conductors will have currents in excess of 3,000 amp. (Determined.)

Along line 25—A 225-kv. potential will appear across the 60-kv. lightning arrester used on a 69-kv. solidly grounded three-phase system while discharging 3,000 amp. (Determined.)

In example 1 it was demonstrated that with a 7½-in. gap setting the control gap would provide a wet switching surge flashover voltage of three times line to neutral on the assumed 69-kv. system. This particular setting also provided a 1-microsecond impulse protective level of 275 kv., which is 85 kv. lower than the 360-kv. basic impulse insulation level. As this control gap provides satisfactory performance from both an outage viewpoint and a protective viewpoint, it is used as a basis of comparison in example 2.

Example 2—Expected Surge and Stroke Performance

Line 17 and E (Diagram 4)

From E, along line 18 to F.—The 1-microsecond protective level to be maintained by the rod gap. (Assumed.)

Along line 26—A 9-in. rod gap has a

1-microsecond impulse flashover voltage of 275 kv. (Determined.)

Along line 27—The 9-in. rod gap has a 60-cycle wet flashover of 105 kv. (Determined.)

Along lines 28, 29, 30 and 31—The 9-in. rod gap which has a 1-microsecond flashover of 275 kv. has a 60-cycle wet flashover which is only 1 9/10 times line to neutral voltage. (Determined.)

Along line 32—Approximately 60 per cent of the total number of switching surges occurring on the system will cause system outages as their potentials are in excess of the 105-kv.. 60-cycle wet flashover of the 9-in. rod gap. The 60 per cent outages caused by the low 60-cycle wet flashover of the rod gap are directly comparable with the 22 per cent outages of the control gap, both gaps providing equal impulse protection. (Determined.)

From E (Diagram 4)

Along lines 33 and 34—A stroke discharge current of 8,000 amp. passing through the 60-kv. lightning arrester used on a 69-kv. solidly grounded three-phase system will cause an *IZ* drop across the arrester equal to approximately 275 kv.

Along line 35—It may be expected that approximately 84 per cent of the direct strokes occurring at the station on the line conductor will produce stroke currents in excess of 8,000 amp. In case 8,000 amp. represents as low as half of the total stroke current, then the total stroke current will be 16,000 amp. It may be expected that a total stroke current of 16,000 amp. will be exceeded by approximately 67 per cent of the direct strokes occurring at the station on a line conductor.

The 69-kv. system voltage used in examples 1 and 2 was chosen only for the purpose of illustration. The chart may be used to make similar comparisons on other system voltages.

The data sources used in compiling the various diagrams of the chart are listed at the bottom of the chart. The following comments are made concerning these data sources:

The basic impulse insulation levels, shown in diagram 1, are a collection of arbitrary voltage levels and may be changed by committee action.

The data as shown in diagram 2 may

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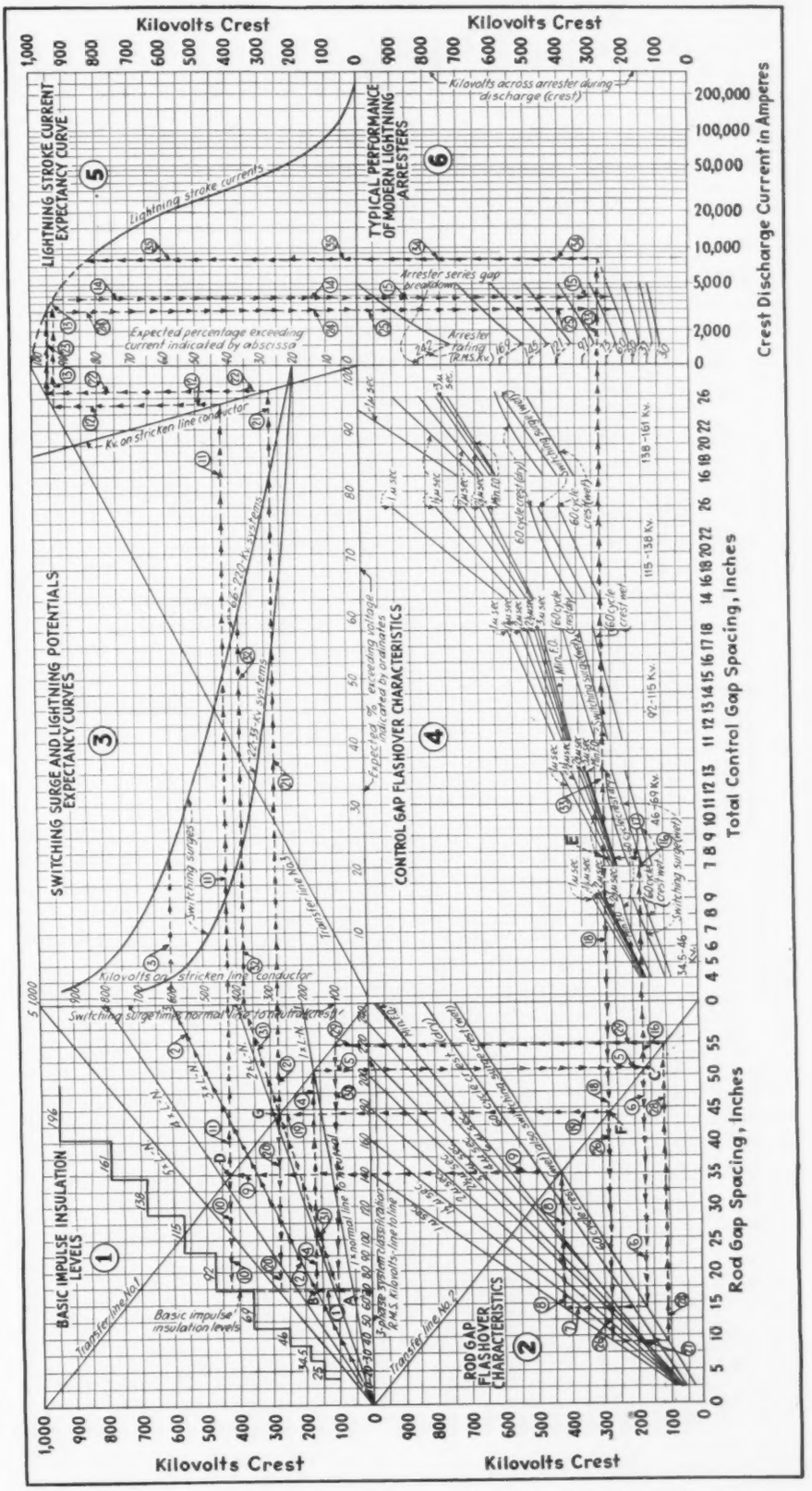


Sources of station protection chart data

Diagram 1—Adopted January, 1937, by the E.E.I.-N.E.M.A. joint committee on system insulation co-ordination. See (1) "Basic Impulse Insulation Levels," Table I, (2) "Insulation Strength of Transformers," Table I, (3) "Application of Arresters and the Selection of Insulation Levels," by Foote and North, Fig. 6, June, 1937, *Electrical Engineering.*

Diagram 2—Positive polarity. 1½x40-microsecond wave, vapor pressure 0.6085 in. of Hg., temperature 25 deg. C., barometric pressure 30 in. of Hg. See "Impulse Voltage Strength of Insulators and Materials," by Dowell and Foust, Figs. 9, 10, 11 and 14, March, 1937, *General Electric Review.* "Also switching surge crest (wet)" has been added to the 60-cycle crest (wet) curve designation of the reference authors as these two curves have been found to be practically the same by test.

Diagram 3—Switching surge potential expectancy curves obtained from "Insulation Co-ordination," by Sporn and Gross, Fig. 1, June, 1937, *Electrical Engineering.* Lightning potential expectancy curve obtained from "Protection of Stations Against Lightning," by Bewley and Rudge, Fig. 1, August, 1937. *General Electric Review.*

Diagram 4—Positive polarity, 1½x40-microsecond wave, temperature 25-deg. C., barometric pressure 30 in. of Hg. See "The Control Gap for Lightning Protection," by Higgins and Rorden, September, 1936, *Electrical Engineering.*

Diagram 5—Lightning stroke current expectancy curve obtained from data presented in Fig. 6, "The Lightning Stroke: Mechanism and Discharge," by McEachron and McMann, October, 1936, *General Electric Review.*

Diagram 6—Typical performance of modern lightning arresters, see "Application of Arrester and the Selection of Insulation Levels," by Foote and North, Table I, June, 1937, *Electrical Engineering.* See also Vogel discussion of this paper, October, 1937, *Electrical Engineering,* pages 1295-6.

Efficient Tint Lighting

By WARD HARRISON*

Engineering Director, Incandescent Lamp Department, General Electric Company, Cleveland

INVISIBLE rays, imprisoned within tubular glass bulbs, now bombard fluorescent chemical powders to produce cool light sources that duplicate all the pastel tints of the rainbow. These new light sources are designated as fluorescent lumiline lamps and they will soon be available to the lighting industry. Because of their ability to produce any desired color and amount of light with greatly reduced heat, they are expected to affect materially many phases of present lighting practice.

Chemical powders hold secret

Specially heat treated and compounded, fluorescent powders hold the secrets of efficiency and color-producing qualities of the new lamps. Functioning as energy transformers, the powders absorb the short, invisible ultra-violet rays and reradiate this energy in those higher wave-bands that comprise the color range of the visible spectrum. Each powder has its own characteristic wave-band with which it responds to the ultra-violet, thus forming its own particular color of emitted light.

The amount of light produced is governed by the intensity and quantity of the ultra-violet energy absorbed, and the efficiency with which this energy is reradiated in the longer wave-bands. One powder will reradiate the absorbed energy in the short wave-band of the spectrum, forming blue light; another, in the long wave-band of the spectrum, providing red light. Thus, by the proper selection and blending of powders, it is possible to produce reradiation in practically any desired part of the spectrum. This permits the production of light in hitherto unobtainable pastel tints as well as pure colors.

The individual powders differ in the efficiency with which they convert the ultra-violet energy into visible light. For this reason, the lamps producing the different colors of light vary within fairly wide limits. The green, for example, has been found to be most efficient, producing 60 lumens per watt in the 30-watt size. The blue is least efficient—about 20 lumens per watt; with white in the intermediate range —approximately 30 lumens per watt. The standard blue-coated tungsten lamps produce only 3/10 lumens per watt, representing an efficiency of less than 1/200th that of the new fluorescent type. The brilliant tungsten filament emits light made up of all colors of the spectrum, and to obtain a single color the others must be absorbed.

Mercury, argon, powder

Within the bulb of the new fluorescent lamp is a trace of mercury, a small amount of argon gas at low pressure and a coating of the fluorescent powder. When the current is turned on the argon serves as a "starter," and in a fraction of a second a feeble blue light with a large component of invisible ultra-violet radiation is generated inside the tube. The ultra-violet radiation strikes the fluorescent coating and is reradiated in the visible range of the spectrum. Like all electric-discharge light sources, the fluorescent lamps require special transformers, or chokes, which serve as valves in controlling the flow of electric current. Unlike some other types of mercury-vapor lamps, however, they attain full brilliancy in a few seconds.

Among the many fields of application for the new fluorescent lamps are the following:

Theater interiors, foyers, rest rooms and marquees; hotel dining rooms, lobbies, rest rooms and ballrooms; in specialty shops and similar departments in large stores—men's wear, furs, beauty parlors, art shops, silk and dress goods; art galleries, cocktail bars, soda shops, night clubs, dance halls, architectural built-in lighting in many forms, show cases, wall cases, vending machines, game machines, music cabinets, luminous signs, mirror lights, vanity table lights, private offices, homes, expositions, railway cars.

The light from the daylight color is the nearest approach to natural daylight that it has ever been possible to produce directly by any artificial illuminant. Light from the white lamp is rather warm in character and objects appear very similar to their appearance under regular Mazda lamps, with the exception of blues, which are decidedly better than under Mazda lamps.

These new light sources can be used in coves, luminous elements, exposed lines, niches, fixtures—all of them singly or in groups.

Manufacture of the new fluorescent lamps is being confined to the 15-, 20- and 30-watt sizes. The lengths of those are 18, 24 and 36 in., respectively, with bulb diameters of 1 in. for the 15- and 20-watt sizes and 1½ in. for the 30-watt size.

* Adapted from papers presented at joint illumination meeting, New York, April 21, 1938.

With Fluorescent Tubes

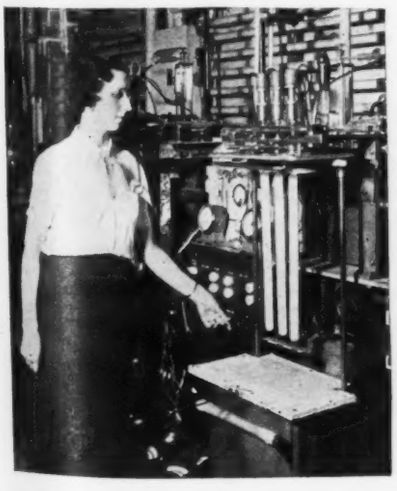
By SAMUEL G. HIBBEN

Director of Applied Lighting, Westinghouse Lamp Division, Westinghouse Electric & Mfg. Company

FLUORESCENT lumiline lamps may be favorably characterized not only by reason of good efficiency in the luminous spectrum but more prominently because they provide the illuminating engineer with a charming palette of color. Their logical services seem to be in the field of decoration or in light ornamentation or in the production of the more gracious kinds of indoor lighting, not altogether coldly utilitarian. Fluorescent sources, therefore, may be characterized as destined to fulfill the demands for lighter duty jobs than the "heavy duty" service of the mercury and sodium-vapor lamps with their uncontrollable color.

Reradiation process

In the commercial fluorescent lumiline lamps the original source is low-pressure mercury vapor, ionized or excited by the arc discharge between coated electrodes. In operation this vapor emits the major part of its radiant energy at wave-lengths too short to be within the visible spectrum, namely, the ultra-violet bands chiefly at 2537A and 3650A. Any such radiation would either be absorbed by the glass walls of the container or, if escaping, would be useless for vision. However, taking advantage of the fact that certain carefully prepared materials can be coated on the inside of the tubing or glass which may absorb these short-wave energies and reradiate them at longer wave-lengths, we find a simple principle of transforming useless into usable light.



Transformed to wave-lengths between 4,000 and 7,500 Angstroms, this radiation readily penetrates the glass wall, and we have a practical illuminant. The color of the ultimate radiation is easily controlled by the proportions of the ingredients in the coating. Since very little energy is required to sustain the discharge arc in the mercury vapor, and since practically a negligible amount of the energy is radiated as heat, the fluorescent lamp is capable of producing 30 lumens per watt or more.

Some idea of the range of colors and of the possible materials available can be gathered from the following tabulation:

Fluorescent Material	*Wave-length Emission Maximum*	*General Color*
Zinc sulphide	4,700 to 5,800 A.	Bluish-green
Zinc sulphide and cadmium sulphide	5,500 to 6,600 A.	Orange-red
Manganese and silver.	4,300 to 4,800 A.	Blue-violet
Cadmium silicate ...	5,900 to 7,000 A.	Pink or red
Magnesium tungstate .	4,300 to 5,000 A.	Light blue
Calcium tungstate .	4,200 to 5,000 A.	Blue
Rhodamine .	5,800 to 6,600 A.	Orange
Anthracine .	4,200 to 5,200 A.	Light blue

The approximate efficiencies for the various colors are:

Color	*Approx. Lumens per Watt*	*Color*	*Approx. Lumens per Watt*
Daylight white	32	Red	3
Warm white	32	Blue	18
Gold	20	Pink	22
Green	60		

The finer gradations of the tints made by adding to the coatings what might normally be called impurities make it possible to secure very lovely pastel colors of visible light which are not dependent upon the usual screening-out process as in the case of colored dyes or glasses.

As in the case of most discharge types of lamps the eventual diminution of output results from a loss of the emission coating from the electrode or the sputtering or evaporation of the metals and hence a residual deposit over the inside walls of the container. Eventually the fluorescent materials may thus become shut off from the short-wave ultraviolet or their brightness dulled, but since the life is not a function of the rupture of a filament, the fluorescent lamps may be expected to have a gratifyingly long life.

It is admitted that fluorescent lumiline lamps involve higher installation costs than corresponding filament lamps but much lower operating costs for equal lumens of visible light. In fact, when considering some of the deeper colors in the production of which the filament lamp is woefully inefficient, the light from the fluorescent device may be from 30 to 50 times more efficient. Furthermore, by careful grading of the fluorescent mixtures it is possible to produce white light in almost any degree.

Essential technical data for Fluorescent Lumilines

Nominal watts (lamp only)	15	15	20	30
Approx. lamp amperes	0.27	0.33	0.35	0.30
Approx. lamp volts	63	50	65	115
Life (hours)	1,000	1,000	1,000	1,000
Base or cap	A-1	A-2	A-2	A-1
Bulb	T-8	T-12	T-12	T-8
Diameter, in.	1	1½	1½	1
Over-all length (including pins), in.	17¾	17¾	23¾	35¾

With the introduction of the fluorescent lumiline lamps by the Mazda lamp manufacturers it seems evident we enter the beginning of an era of really painting with light.

Editorials

S. B. WILLIAMS, Editor

"How's Business?" Facts on the First Quarter

THE universal question today as groups of men gather at convention sessions, meetings, conferences and luncheon tables is "How's business?"

After the welter of opinions, haphazard comments and emotional outpourings there is nothing like a set of facts which a practical man may subject to quantitative analysis.

Such a set of facts is provided by the reports now being issued which give the record of what happened in the first three months of this year compared to the corresponding period a year ago. General business, railroads and utilities are now presenting reports which permit a fairly general survey and a correct survey, because it is based upon facts.

First of all, according to the more popular indices, business as a whole has not disappeared; it is still proceeding, at three-quarters of the volume it had a year ago.

Secondly, the current analysis by the National City Bank of 280 domestic companies engaged in manufacturing and trade shows combined net earnings of $100,000,000, compared to a first quarter net in 1937 for the same companies of $309,000,000, a drop of 67.5 per cent. Of interest to utilities is this further comparison: 1938 first quarter profits on capital and surplus were 3.7 per cent, compared to 12 per cent in the first quarter of 1937.

Now, let's look at the Class I railroads. For the first quarter their net was $19,276,663, compared to $147,514,808 in the same quarter a year ago. This is a drop of 87 per cent. Of interest to utility men is the fact that the rate of return is 0.39 per cent, compared to 2.95 per cent for the first quarter of 1937. If it is true that when we get down to the cellar floor there is no further to go, then the rails are on the bottom. For few realize that today the total carloadings are back to where they were at the bottom of the depression in 1932.

Finally, where do the utilities stand? It is now possible to get the first quarter or March comparisons for an assortment of companies, including Consolidated Gas, Electric Light & Power Company of Baltimore, Kansas Gas & Electric, New England Power Association, Tampa Electric, Sierra Pacific Power, Pennsylvania Water & Power, Commonwealth Edison, Idaho Power, Nebraska Power, Louisiana Power & Light, Philadelphia Electric.

Baltimore's net of $1,657,919 is down 10.7 per cent for the first quarter, Philadelphia's net of $5,727,582 is down 6 per cent, and Pennsylvania Water & Power's net is up slightly.

For March, 1938, Kansas Gas & Electric's net of $101,667 is up 12.1 per cent. Idaho Power Company's net of $101,844 is up 8 per cent, although Louisiana's net of $35,876 is but one-half of the net last March. Minnesota Power & Light had a March net of $80,707, down 34 per cent, whereas Tampa's March net of $141,626 was up 8.4 per cent, Sierra Pacific's net of $45,723 was up 6.7 per cent and Nebraska Power Company's March net of $124,343 was up 5 per cent.

It would be much more helpful to be able to give over-all figures for the utility industry, but unfortunately some of the companies still report only twelve months' earnings, which are not suitable for comparisons of this nature.

The cross-section given above does, however, high-spot some recent trends of utility net earnings, and it will be noted that they shine by comparison with railroads and general business for the same period.

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An Industry Rendezvous

YEARS ago the old N.E.L.A. conventions were the nearest thing the electrical people had to what might be called an all-industry meeting. At times between five and ten thousand people attended, and since everybody that was somebody found his way to the convention it attracted manufacturers, wholesalers, contractors and others.

Five-and-a-half years ago the N.E.L.A. gave way to a new organization, the Edison Electric Institute. Because this was a trade association devoted more to management problems than to operating details, the attendance at the conventions naturally fell off. But again they are growing, with a total attendance last year of more than two thousand. Business conditions can, of course, reduce the attendance this year somewhat, although there are some indications that a new record for E.E.I. conventions might be hung up.

Two things are happening. In the first place, the utility attendance is broadening to include not only top executives but also a growing number of the younger men, upon whom the industry must look for management in the not too far distant future. Secondly, as in the old N.E.L.A. days, the meeting is attracting people in other branches of the electrical industry.

Say what one may, the utilities are the hub of the electrical industry. Whatever affects their business

affects the business of the rest of the industry. Their programs to expand or develop markets are immediately reflected in the activities of the other groups. Particularly has this been true during the past five years when the utility industry has sponsored one after another different co-operative market development campaigns.

Since the advent of the E.E.I. there has been a closer co-ordination of inter-industry activities. This in itself has undoubtedly been responsible for some part of the group interest in E.E.I. conventions by non-utility people. And as the understanding of the mutuality of interest grows in the thinking of the utility industry and is acknowledged in works the more will this convention take on the appearance of an all-industry meeting.

And why not? It is so much easier, less expensive, more resultful to reap the benefits of collective efforts.

In just another month the sixth annual E.E.I. convention will be held, this year at Atlantic City. The program will be good, but the outside-the-meeting conversation will be most important. What are the problems? How are they being met? What can be expected? A better understanding of conditions and activities elsewhere can encourage local operators. Manufacturers and other electrical men can better gauge prospective business.

With business conditions as they are, the convention at Atlantic City next month ought to draw a large gathering of serious business men—men who want to know what others are doing and what they themselves can do to push business forward.

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Trends of Large Company Operations

FOR the twenty-sixth time ELECTRICAL WORLD presents its survey of the operations of the large utility systems—those having an output of one hundred million kilowatt-hours and over. In the beginning the interest was largely in the order of magnitude, but today that interest, while probably continuing, is to a great extent replaced by the trend information, for these systems, 180 in number, account for approximately 90 per cent of the energy output of the entire industry.

The utilization and load factors as analyzed show a definite trend toward greater employment of all facilities, although in some places it would appear as though the margin of reserve was being shaved a little thin. And in this connection it would be interesting to speculate what would have happened had the usual December peaks occurred last year. There was a peak, but it came much earlier due to the gradual falling off in industrial load during the fall and winter months.

With the new generating capacity that is being added this year, it is doubtful if the trends will continue in 1938. That, however, is believed to be only a temporary relapse, and as soon as consumption picks up the trend toward higher factors will continue. If this is not carried too far it can be just as economical as fractional gains in fuel consumption, if not more so.

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The Legacy of an Emigrant

SIXTY-EIGHT YEARS ago an accomplished mechanic arrived in this country. He was practically penniless, but had come determined to tie electricity somehow to the chemistry he had learned while apprenticed to a physician in his native England. Faraday had inspired him. A job in a nickel-plating plant led within four years to a partnership in this field of enterprise. Here the incentive was to develop a d.c. dynamo to supplant the primary batteries which were being used for electroplating. The design, first of the multi-polars with salient pole pieces, was patented in 1875. A typical American career had thus been launched in just five years after the arrival from foreign soil.

All this was, however, just a foundation for the life work of Edward Weston, who won world-wide fame for instrument refinement and precision. Out of his home laboratory came in 1888 the first direct-reading measuring instrument which had been awaited as an escape from the cumbersome and tedious tangent galvanometer. This Model 1 instrument was described in detail in ELECTRICAL WORLD, November 17, 1888, about six months after he had formed the Weston Electrical Instrument Company. Pioneering research of a high order had resulted in a non-magnetic, high-conductivity alloy with appropriate temperature characteristics that could be used in spiral springs to conduct the current to the moving coil and simultaneously provide the controlling torque in deflection. Manganin followed and then tubular pointers and a chain of now familiar developments which give today's electrical instruments the portability, sustained accuracy and refinement of performance which are little short of marvelous to the lay observer who compares them with the quaint tools of the pioneers.

Edward Weston's career is the history of the company he founded, which this year is celebrating its Golden Anniversary. It is another example of a penniless emigrant who by dint of talent, initiative and persistence extended the horizon of electricity. Further than that, in these times of utilitarian appraisal, the creditable accomplishment is the creation of an enterprise giving steady employment to well over a thousand workers.

Tax-Exempt Securities

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

TAX-EXEMPT securities for rich tax dodgers—even if they help government ownership projects of the "yardstick" variety by providing cheap interest rates—have become a pain in the neck for the New Deal. It brings back memories.

President Roosevelt was strong for economy in the government—in 1932. And even in early 1933. Remember the "economy" bill?

Up to about that time Andrew W. Mellon was the "greatest Secretary of the Treasury since Alexander Hamilton."

But Roosevelt abandoned economy, forgot all about his idea—stated during the depth of the depression in 1932—that government expenses should be cut 25 per cent. On that day Mellon became anathema to the New Deal publicity machine. Not even his death stopped the abuse. His crime? That the Treasury paid off nearly ten billions of dollars of national debt during his régime, a contrast with what has been happening since that required, politics being what it is, rather drastic camouflage.

But it's a long road that has no turning, and now Roosevelt is advocating one of the great issues which Mellon preached—the end of tax-exempt refuge for rich tax dodgers.

It still wouldn't do to let Mellon up, so to speak, so at once the motives which inspired Mellon in this fight to which Roosevelt is the latest recruit are impugned. Mellon was selfish, we are told. His object was to make government ventures in business, such as municipal electric systems, hydro-electric developments, etc., more difficult.

Roosevelt's motive, of course, is not that. Most Washington observers who listened to Mellon on the subject from 1921 until he went to England are rather surprised to hear that it was his. He certainly had plenty of other arguments, and, strange as it may seem, the more forceful of them seemed astonishingly similar to those now voiced by Roosevelt.

But it's not a bad idea, at that, and the electric industry should thank the New Deal publicity men for scaring it up. Not that the electric industry didn't know all about this angle of tax exempts, but the more publicity there is for it the better, from the standpoint of the electric industry.

For the whole story against government ownership is a pocket-book story. Political management costs more than profit-inspired management. Lots more. But this extra cost is cunningly concealed. Taxes are just part of the smoke screen, but an important part. Tax-exempt securities are only part of the tax phase. Tax-exempt plant is another. Loss to the government of income taxes that would result from a profitable privately operated electric company is another. And that is just the beginning.

So more power to the latest attack on Mellon!

Senator Vic Donahey

A serious injustice was done Senator Vic Donahey, chairman of the Congressional committee which is to investigate TVA, in this column in the April 23 issue. The reference was to a story that, while state auditor of Ohio during the administration of Gov. James M. Cox, Donahey "forced a state judge to itemize a dinner on an expense account, and then disallowed a 35-cent charge for potatoes. 'Not while the farmers of Ohio are only getting 65 cents a bushel,' he told the newspapers. Months later he quietly approved the expense account. No publicity then. So the farmers thought he was like Calvin Coolidge."

Then the article went on to say that he was so popular he was elected governor, in 1924, for a second term, by 176,842 majority, although on the same day the Ohio voters gave Coolidge 698,242, "probably the most spectacular instance of a man running ahead of his ticket in the entire political history of the U.S."

"It is noted," Senator Donahey has since written me, "that you refer to the baked potato incident with the observation that 'Months later he quietly approved the expense account. No publicity then.' This statement is not in accordance with the facts. I do not know where you got your information, at least you did not consult me about it nor any member of my staff. I want you to know, and I expect your statement to be corrected, that I did not pass the controversial voucher for payment, and it was not approved until a succeeding Auditor of State issued voucher in payment of this account.

"I do not think you meant to be unfair, but I do believe you were misinformed, and this erroneous statement to the public should be corrected."

The writer is distressed to have offended Senator Donahey, and to have done him an injustice, but he is delighted to have the readers of ELECTRICAL WORLD get this very illuminating slant on the man who is now chairman of the committee which will investigate the TVA. It is refreshing that a public official should take so seriously extravagance, even in so small an item, in spending the people's money.

It is also interesting because the *reasons* for Senator Donahey's appointment have leaked out since the earlier item was written. The extraordinary independence of Donahey was stressed in that article. And there has been much wonder why a man so unlikely to take orders blindly from the White House should have been named. So a friend asked Vice-President Garner.

"Donahey is an auditor," replied Garner. "And so few senators are apt to understand figures."

Plenty of auditing, incidentally, will precede any fireworks displays that may enliven the TVA investigation. W. O. Heffernan, named by

[*Continued on page 119*]

News OF THE WEEK

Engineers Seek to Define Rating of All Power System Equipment

Engineering committees of Edison Electric Institute meet in Chicago — Find need for uniform definition to rate equipment — Kellogg suggests talent be directed toward field of utilization of power

Strongly observable in the deliberations of the Edison Electric Institute engineering committees, in session this week in Chicago, was the impact of the greatly increased governmental regulation of electric utilities of recent years on the engineering thinking of the industry. The necessity for specific and uniform definition of all system elements, both as to rating and to function, is forcing engineering thought into ways that are new.

Exact definition of a transmission line and where transmission merges into distribution are being sought. What is the rating of a piece of equipment? Is it what the nameplate says or is it the load it usually carries, or may it not be the load it could easily carry if need requires? There is searching of minds as well as of records by utility engineers for answers, and the questions thus raised were discussed in almost all of the committee sessions.

Another aspect of the new problems confronting the engineers of the industry was indicated by C. W. Kellogg, president of the Institute, in an address at the joint dinner meeting of all committees. Mr. Kellogg suggested "that perhaps the outstanding field to which first rate engineering talent should now be directed is that of utilization. It is quite possible," continued Mr. Kellogg, "that a more perfect co-ordination of power supply clear through to the utilization devices themselves would achieve for the consumers better service at less total cost to them."

Considering the additional burdens imposed by more stringent requirements of governmental regulation, together with the implied invitation for the engineer to extend his interest beyond the business of supply and into the utilization of electricity, it was stated by Mr. Kellogg that the job of the utility engineer is yet far from being done.

A wide range of subjects were discussed in the committee meetings. Of especial interest was the symposium on transmission line design and operation which opened the sessions of the transmission and distribution committee. Another intriguing discussion was that of the hydraulic power committee on comparative costs of private and government hydro plant construction. This was enlarged to include steam plants. Conclusion was that both kinds of prime mover had their economic places and that neither should wander out of them.

The accident prevention committee exhibited some perturbation regarding the fact that the accident rate among electric utilities has been rising in the past two or three years. The causes, therefore, were argued to no final agreement beyond the action of the committee toward analysis of records to determine time and locus incidence of accidents. The committee occupied considerable time with the matter of electric fencing as a preliminary to anticipated action to be embodied in the National Electrical Safety Code.

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House Passes Bill to Install Power at Fort Peck Dam

The House of Representatives this week passed a bill authorizing the installation of electric generating machinery at the Fort Peck Dam on the Missouri River in Montana as rapidly as a market therefor can be developed, at an ultimate cost of $6,800,000.

In accordance with the pattern established at the Bonneville project, control of the project is divided, the Corps of Engineers being placed in charge of construction, maintenance and operation of the project, but not of the marketing of the power. When passed by the Senate July 22, 1937, the bill called for an Administrator to perform this function, but the House before voting amended the measure to place the power distribution under the Bureau of Reclamation.

The bill now goes back to the Senate for action on the House amendments.

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Zimmermann Sees U.G.I. Dividend Set

Belief that United Gas Improvement Company can continue the present dividend to the close of the year was expressed this week by John E. Zimmermann, president, at the annual meeting of stockholders. He said that this could be done "if nothing unforeseen or of an unusual character happens." The present rate is $1 a year.

Mr. Zimmermann said that combined earnings for March were 8.4 per cent less than last year. "For the first quarter of this year there was earned for the common stock 26.6 cents, as against 29.5 cents in the corresponding quarter of last year, or a drop of 9.7 per cent," he said.

It was pointed out by Mr. Zimmermann that U.G.I. owns over 2,000,000 shares of common stock of Public Service Corporation of New Jersey and if the dividend of the New Jersey utility is cut it will be reflected in U.G.I. earnings.

"To forecast the future is always difficult," Mr. Zimmermann said. "This difficulty is increased because of the present disturbed condition of business. However, as I view the situation at the moment I believe that we can reason-

ably expect combined earnings for the year of $1 a share, but that our income will be short of meeting the $1 dividend. However, since the stock was reclassified in 1929, we have had an excess of income over dividends amounting to $8,734,037, and at the present time earned surplus is over $35,000,000 in addition to a contingent reserve of over $26,000,000. We had cash and government securities aggregating $5,857,700 after the payment of the March dividend."

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Short Circuit Causes Hudson Power Failure

Last week the city of Hudson, N. Y. was thrown into darkness when a short circuit in the substation of New York Power & Light Company blew out transformers. In addition to the disabling of the transformers, both normal and emergency feeder lines and cables were burned out.

Reports stated that Albert Woodhead of the utility in Albany said that the power failure, about 3 p.m., was caused by an "unprecedented series of failures of substation equipment."

Engineers from Albany were rushed to Hudson to determine the origin of the failure and to restore service. Power was in use by 8:10 p.m.

Mr. Woodhead stated that communities north and south of Hudson were supplied power from other sources.

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Virginia Public Service Denies Wasting of Assets

The Virginia Public Service Company last week denied before the State Corporation Commission that it had "milked" away its operating assets.

The company filed the denial following an investigation by the state instigated by the accusation of Alexander Speer, deposed president of the utility, that holding companies and their affiliates were interfering with its operations. At the same time the utility denied that the Eastern Power Company, an Associated Gas & Electric affiliate, had the power to dominate Virginia Public Service.

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Hiwassee Dam Contract Let

Announcement has been made that TVA has awarded at $120,800 a contract to Consolidated Steel Corporation of Los Angeles, Calif., to supply ring seal gates and auxiliary equipment to be installed in the four regulating conduits at Hiwassee Dam.

Higher Operating Cost and Taxes Offset Increase in Utility Revenue

Edison Electric Institute annual statistical bulletin gives figures of industry operation — Power companies pay $1 out of $6 collected from customers in taxes — New data classification to be adopted

The effects of increased operating costs and taxes in offsetting gains in revenue from the increased use of electricity are pointed out in the Edison Electric Institute's annual statistical bulletin by Charles W. Kellogg, president.

While operating revenues increased $114,000,000 during the year, operating income of the private power companies showed a gain of only $5,000,000, or 1.5 per cent over 1936. Taxes in 1937 totaled $330,000,000, or almost one dollar out of every six received from customers. Taxes paid by the power companies have increased 60 per cent in the past five years.

Gain in customers

During 1937 there was an increase of 958,108 customers, or 3.7 per cent over the 26,205,879 customers served at the close of 1936. This constituted the largest increase in any year since 1929. The industry is now serving 27,163,987 customers, including 1,241,505 farm, 21,697,515 residential and 3,891,584 small and 259,678 large commercial.

In 1937 the industry sold 99,446,364,000 kw.-hr., an increase of 10.4 per cent over 1936. Total revenue was $2,180,787,600, against $2,044,586,900 in 1936, a gain of 6.7 per cent.

Approximately 1,000,000 kw. of new capacity was added during 1937, and at the close of the year the industry had 34,960,321 kw. of capacity, against 34,260,071 kw. at the end of 1936. During the year 970,000 kw. of new capacity was installed and about 270,000 kw. of older or more obsolete equipment was retired, resulting in a new increase of 700,250 kw.

The total gross construction expenditures of the industry, exclusive of TVA and other government projects, amounted to $455,480,000, about 60 per cent more than the $289,710,000 in 1936. For the first time in several years expenditures for generating facilities constituted a substantial proportion of the total, amounting to $124,000,000. Substation and distribution system expenditures totaled $252,000,000, against $200,000,000 in 1936, much going into new rural lines. Transmission expenditures totaled $41,000,000, or double the 1936 figure.

It was pointed out that the power industry merchandises only about 16 per cent of total volume of merchandise sales, exclusive of radio sets and tubes. Sales in 1937 totaled $662,023,000, of which $103,291,000 was sold by utilities, the remainder by other outlets.

Mr. Kellogg stated that national promotional sales programs and the availability of improved appliances at prices within the purchasing power of more residential and farm customers have been the principal factors in bringing about the increased household use of electricity and the lowering of the average electric rate.

The average urban and non-farm customer used 793 kw.-hr. in 1937, against 727 a year ago; the average revenue was 4.39 cents a kw.-hr., against 4.65 cents, and the average bill was $34.81, against $33.81 a year ago. It is estimated that $6 of this goes to government in taxes.

It was pointed out by the Institute that this is the last of a series of annual statistical bulletins, beginning in 1926, which will follow the accepted classification of customers according to rate schedules. In the future statistics will be made according to the new system of classifications promulgated by the Federal Power Commission. However, later in the year E.E.I. will revise the bulletin of 1937 to show the new system for comparison purposes with the 1938 figures.

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Utility Men to Address A.M.A. Insurance Conference

A complete panel of speakers and topics for the ninth annual insurance conference of the American Management Association, which is to be held at Atlantic City May 9–10, has been announced by Joseph H. Nickell, insurance manager of the Philadelphia Electric Company and vice-president in charge of the A.M.A. insurance division. The major topics will be the general problems of industrial insurance and specific problems of industrial insurance administration. Among the speakers will be C. W. Kellogg, president Edison Electric Institute, and Solton Engel, manager insurance department, Consolidated Edison Company of New York.

Memphis Ready to Make Purchase Offer for Properties of Utility

Results of negotiations between officials of Memphis Power & Light and city are expected to be made public in near future — Allen confers with Washington on PWA and RFC aid — City to make one offer

Negotiations looking toward the purchase of the properties of Memphis Power & Light, subsidiary of National Power & Light, by the city are expected to result in a showdown in the near future. During the past month Paul B. Sawyer, president of National Power & Light, has been conferring with Memphis officials in an effort to reach agreement on the valuation of the properties and their purchase by the city.

Last week Major Thomas H. Allen, chairman of the Memphis Board of Light and Water Commissioners, which is negotiating for the purchase of the utility properties, was in Washington conferring with Dr. Clark Forman of PWA, David E. Lilienthal of TVA and Chairman Jesse Jones of RFC.

Ready to make offer

Upon his return to Memphis, Major Allen explained that the city was ready to make its one and only offer. "All of the problems of the city are settled," he said.

City officials are now determining the terms of the offer and price it is willing to pay for the properties. Major Allen said that the city would "avoid making statements that might influence the price of Memphis Power & Light securities" on the theory that if the sale is made both preferred stocks and bonds will increase in price and if the sale falls through prices of these securities will drop.

So far the RFC has made no commitments on financial aid to Memphis. The city had a cash surplus of $922,,000 on January 1, last, and a net bonded debt of $20,000,000. In view of this financial condition the city expects to sell its own bonds to finance the purchase. RFC might be asked to advance the funds provided the interest rate is low.

TVA to take over lines

In the present set-up the TVA would take over the transmission lines of the Memphis utility and the PWA would aid in repair work and extension of the system, which city officials declare to be overloaded and in need of renewals. The city has decided that it could operate the gas distribution system "at a profit," although no decision has been reached. The gas system has a rate base of more than $7,000,000, while the rate base of gas and electric system is $26,000,000, a figure which the city officials declare to be "considerably out of line."

Negotiations for the sale of the Knoxville properties have been sidetracked pending the completion of the Memphis deal. However, should the Memphis negotiations fail, the city is ready to go ahead with its present PWA contracts. This provided a loan and grant for construction of a distribution system and purchase of TVA power. Part of this system is now under construction. The situation, as observers see it, is a case of sell or face competition.

Wide World

TVA COMMITTEE—Members of the joint Congressional committee recently appointed to investigate the Tennessee Valley Authority meet to plan the inquiry. L. to r. seated: Senator Lynn J. Frazier, Senator Vic Donahey, chairman; Senator James J. Davis and Rep. Thomas A. Jenkins. Standing: Rep. Charles A. Wolverton; Rep. William J. Driver; Senator H. H. Schwartz; Rep. Ewing Thomason; Rep. James M. Mead and Senator Fred H. Brown

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Sue Municipal Plant for Rate Reduction

An injunction suit over light and water rates charged by Forrest City's (Ark.) municipally owned plant has been filed in the Chancery Court of St. Francis County. The suit asks for an order to reduce the rates 44 per cent on the basis of 1937 receipts. It also seeks to enjoin the defendants and their successors in office from making any further "unauthorized expenditures and improper diversions" of funds. The suit was brought by J. M. Williams as plaintiff, for himself and all similarly affected consumers. Mr. Williams charges that he and other consumers are required to pay for water and energy at rates which are "excessively and unlawfully high, and as such constitute illegal exactions from him and others."

City Council in session March 1 adopted a new schedule which would cut residential rates approximately 11 per cent and commercial rates about 12 per cent.

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Goodwin in Picture

In the picture of the Weston Electrical Instrument Corporation celebration in the April 30 issue, W. N. Goodwin, Jr., chief electrical engineer, was second from the left, with H. L. Gerstenberger on his right and Mr. Weston on his left.

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TVA Inquiry Set in Fall

W. O. Heffernan, newly appointed clerk of the joint congressional committee which is to investigate the TVA, expressed the opinion that the committee would have "no hearings of any kind until fall." Mr. Heffernan stated that he did not expect to form the committee's staff until after he had made a trip to the TVA area to study the set-up.

Northwest Engineers Hold Section Meeting

Broad discussions of interconnected systems occupied a prominent place on the lengthy program of the engineering and operating section of the Northwest Electric Light and Power Association at its fifteenth annual general meeting at Vancouver, B.C.

Major utilities in the Northwest have operated in parallel for years, but only recently have been forced to pump continuous, heavy loads over long, thin ties. Subsequent tendency of systems to separate under inexplicable load swings have necessitated intensive studies of governing and control.

In a summary of the studies of governing and control, M. L. Blair, Washington Water Power, stated that the next step in perfecting the Northwest interconnection awaits results of tests to be made with an instrument for simultaneously recording two electrical and two mechanical characteristics, such as motion of governor parts. E. H. Collins, W.W.P., announced that this instrument will be made available to other companies in the region.

Chairman A. Vilstrup and President W. C. Mainwaring, both of B.C. Electric, made remarks at the opening of the meeting. R. S. Maxwell, Puget Sound, in discussing accident prevention, stated that "management almost always carries a moral responsibility for an accident and must constantly resist the tendency to put blame elsewhere."

Twelve papers were presented by the utilization committee, headed by Walter Brenton, chief engineer of Portland General Electric. Two tendencies were evident: (1) Engineers' growing appreciation of the commercial value and ultimate public benefit of utilization devices, and (2) the effort to secure more comprehensive data on load factors of individual devices and their relation to over-all load factor.

Firing sawdust

The power production committee gave considerable attention to the local problem of steam plants firing sawdust. J. H. Steede, B.C. Electric, discussed operation and maintenance of glass bulb mercury-arc rectifiers. The company recently installed more than 600 kw. of these units to serve a part of its street car load.

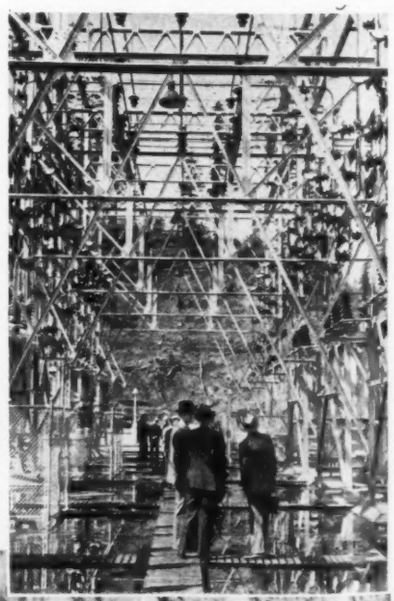
The transmission and distribution committee reports included an analysis of system economics by Magnus T. Crawford, Puget Sound, and L. R. Gamble, W.W.P., on recent transmission construction activities, particularly his company's job along Lake Chelan. J. H. Hellenthal, Puget Sound, headed the electrical equipment committee with papers delivered on interconnection, phase-angle control, pilot wire relay protection on the Puget Sound-Seattle tie, and recent developments in assorted equipment.

Maryland Utility Body Names New Officers

New president of the Maryland Utilities Association is R. C. Brehaut of the Washington Suburban Gas Company, succeeding D. E. Stultz of the Potomac Edison Company, who is retiring to become a member of the board of directors.

Other officers of the group, elected at the recent annual meeting in Baltimore, are: W. D. Haley, Washington Suburban Gas Company, secretary; R. F. Bonsall, Consolidated Gas, Electric Light & Power Company, re-elected treasurer; Joseph A. Stoll, Baltimore Transit Company, vice-president. Harold G. Haydon and R. L. Smith, Potomac Electric Power Company, and Lewis Payne, Eastern Shore Public Service Company, were re-elected directors; Harold Schell, Hagerstown Light & Heat Company, was elected a new board member.

At a meeting of the electric group of the association H. C. Thuerk, Utility Management Company, talked of "Distribution Factors to Be Considered in Selling the Profitable Load." His talk was followed by a series of ten-minute presentations on operating, commercial and accounting subjects by representatives of member units.



MEET IN NORTHWEST—Many delegates at the recent engineering and operating section of Northwest Electric Light and Power Association viewed the trussed design of this (right) switching structure atop the Ruskin power house. Below left—A. Vilstrup, chief engineer B.C. Electric, conducts John Bankus, engineer, and Walter Brenton, chief engineer of Portland General Electric, on inspection of B.C.'s new Grandview substation. Center—Bagpipes lead a procession to the luncheon sponsored by Vancouver Electric Club. On lower stair are E. E. Walker, B.C. Electric, and Mrs. E. E. Carpenter, hostess to attending ladies. On stairs above are (left) President W. C. Mainwaring and Mr. Vilstrup of B.C. Electric. Right—R. J. Davidson, Pacific Power & Light; C. W. Colvin, B.C. Electric; H. A. Patton, Washington Survey and Rate Bureau, and Mr. Brenton

Trend Is Still Downward

Week's energy output is 11.6% under 1937 — Decline reflects reduced industrial activity

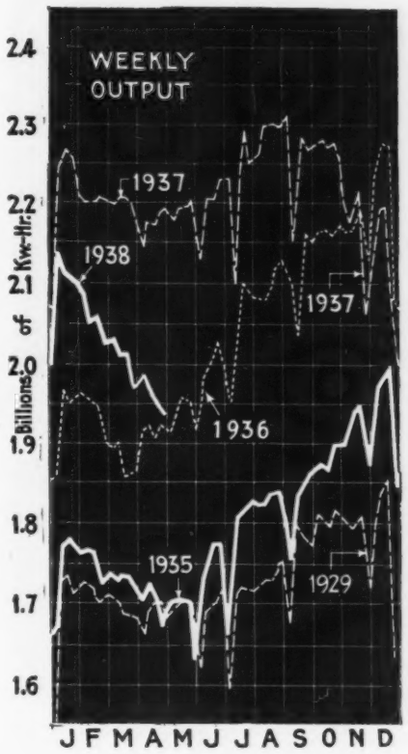
The output of energy by the electric light and power industry during the week ended April 30 sagged off, by 0.7 of 1 per cent, to 1,938,660,000 kw.-hr., according to the Edison Electric Institute. This is 11.6 per cent less than the amount generated in the corresponding period a year ago, making the disparity, as against 1937, the largest thus far recorded. Production is still above the level of 1936, but the margin has worn down to a fraction of 1 per cent.

The decline, which began last September, was at first irregular, but during the past four months it has gone on steadily and more steeply than is normal at this season.

The nearest approach to 1937 output was again on the Pacific Coast. The greatest recession was in the Rocky Mountain region. In the Central Industrial region and New England severe curtailment of industrial activity is indicated by the continuously smaller use of energy than a year ago.

Weekly Output, Millions of Kw-Hr.

1938	1937	1936
Apr. 30..1,939	May 1..2,194	Apr. 25..1,933
Apr. 23..1,951	Apr. 24..2,188	Apr. 18..1,915
Apr. 16..1,958	Apr. 17..2,173	Apr. 11..1,934
Apr. 9..1,990	Apr. 10..2,176	Apr. 4..1,916
Apr. 2..1,979	Apr. 3..2,147	Mar. 28..1,867
Mar. 26..1,975	Mar. 27..2,200	Mar. 21..1,862
Mar. 19..2,018	Mar. 20..2,211	Mar. 14..1,901



Per Cent Change from Previous Year

Region	Week Ending Apr. 30	Apr. 23	Apr. 16
New England	−12.1	−10.5	−13.7
Middle Atlantic	− 6.0	− 5.7	− 3.5
Central Industrial	−18.4	−18.7	−17.7
West Central	− 7.2	− 6.4	− 3.7
Southern States	− 9.1	− 8.5	− 6.1
Rocky Mountain	−26.8	−24.6	−22.5
Pacific	− 3.5	− 0.4	− 1.4
United States	−11.6	−10.8	− 9.9

Carolina Utilities Ask Santee-Cooper Rule

Three South Carolina utility companies—Carolina Power & Light Company, South Carolina Power Company and South Carolina Electric and Gas Company—last week asked the U. S. Supreme Court to review a decision of the Fourth Circuit Court of Appeals dismissing their application for an injunction against the construction of the Santee-Cooper navigation, flood control and power project by the South Carolina Public Service Authority with the aid of federal funds.

The companies contend that "the construction, maintenance and operation of the project by the state agency is itself illegal," and also contest the use of federal money in building facilities that will compete with them.

The Santee-Cooper project involves the diversion of water from the Santee River to the Cooper River through an abandoned canal and includes two reservoirs totaling 1,400,000 acre-ft., a power house with eight 25,000-kva. generators and about 600 miles of transmission line, at a total estimated cost of $37,500,000.

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TVA Starts Line Survey

TVA has started a survey between Okolona and West Point and Starkville and Okolona in Mississippi for the purpose of extending its service into additional territory. Negotiations between TVA and Mississippi Power for sale of the utility's properties in that region have begun. If the sale is not arranged TVA plans building its own system, officials of TVA declare.

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Proposes $130,000 Issue

Voters of Hillsdale, Mich., will decide a proposed $130,000 bond issue at a special election, the proceeds of the bonds to finance proposed additions to the municipal power plant at Baw Beese Lake. Bonds would be retired from earnings of the plant.

E.E.I. Meeting to Talk On System Operation

Important discussions of system operations and sales will highlight the annual convention of the Edison Electric Institute, to be held June 6 to 9 in Atlantic City.

Walter H. Sammis, vice-president of Commonwealth & Southern, will outline the sales approach to two important power sales problems—meeting competition and directing sales effort toward the profitable load. H. S. Metcalfe, director of public relation of West Penn Power, will talk on the present-day public utility advertising. Harry A. Snow, controller of Detroit Edison, will give an analytical discussion of electricity sales.

Factors which have tended directly and indirectly to increase accounting costs will be discussed at the Tuesday afternoon session by B. S. Rodey, chairman of the general accounting committee and associate controller of Consolidated Edison Company of New York, Inc. He will point out means of possible accounting economies and means of offsetting the tendency toward higher costs.

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Utility Petitions Registered With SEC

Kansas Electric Power Company, subsidiary in the Middle West Corporation system, has filed a declaration with the SEC under the holding company act covering the sale of $1,000,000 of its first mortgage bonds, series A, 3½ per cent, due December 1, 1966, and 7,000 shares of no par common stock. Bonds would be privately sold to the Equitable Life Assurance Society of the United States and the common stock to the Middle West Corporation.

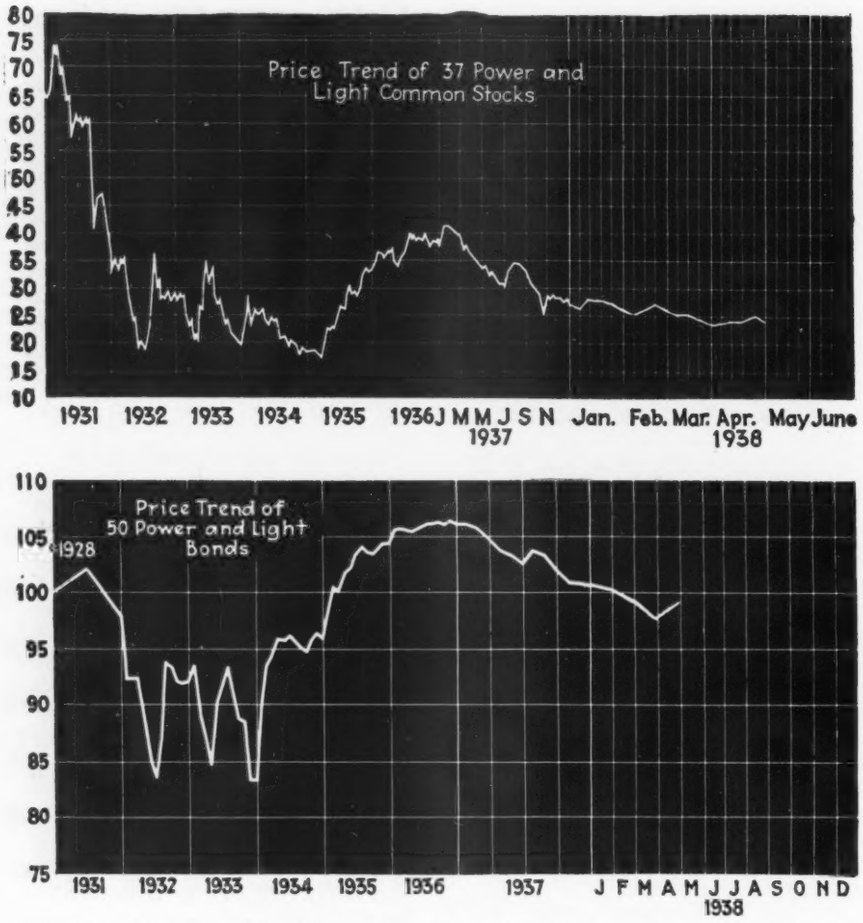
Other utility statements filed with SEC follow:

Columbia Gas & Electric Corporation and two of its subsidiary holding companies, Atlantic Seaboard Corporation and Huntington Gas Company, have filed statements on Form U5-B, the complete form for registration under the holding company act.

Commonwealth & Southern Corporation of New York has filed a declaration under the holding company act with respect to its organization and conduct of business as a subsidiary service company for the registered holding company system of the Commonwealth & Southern Corporation, Delaware.

Central Maine Power and Public Service Company of New Hampshire, both subsidiaries of the New England Public Service Company, have filed applications for exemption from requirement for filing a declaration covering issuance of securities to be used for payment of bank loans and other purposes.

Utility Stocks Hold; Bonds Rise



Utility stocks advanced slightly last Tuesday, with lighter trading reported. For the week, the "Electrical World" index dropped 0.6 point to 24.5; previous week, 25.1; a year ago, 34.2. Utility bonds gained during the month, the "Electrical World" index advancing 0.8 point to 98.4; index previous month, 97.6

Cities Service Cuts Common Stock Value

Stockholders of Cities Service Company, at their annual meeting in Dover, Del., last week approved the proposal to reduce the stated value of the common stock and exchange the shares on the basis of one new share for ten old ones. The largest group of stockholders since 1931—more than 61 per cent of the vote of the share owners—were present at the meeting.

The stated value of the common stock was reduced from $187,278,350 to $37,455,670. Par value of the common stock was fixed at $10 a share instead of no-par value. The 37,804,394 shares will be reduced to 3,745,567.

There were 1,737,000 votes for the change and only 5,600 shares against, with more than 230,600 stockholders participating. Only 152,000 were represented last year.

Henry L. Doherty, W. Alton Jones, Warren Foster, George H. Shaw and George MacDonald were elected directors for a three-year term.

Mr. Jones explained that the change in the common shares was to create a capital surplus to be used to write down on the books of the company the carrying value of certain assets.

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Utilities Power & Light Worth Shows Shrinkage

The worth of Utilities Power & Light Corporation today is only about one-fifth of its original value, Charles True Adams, trustee, testified at a hearing on applications for interim fees and expenses before the SEC in Chicago. It was indicated that the present worth is between $49,000,000 and $58,000,000, he said, as against an original worth of more than $250,000,000.

Mr. Adams said that savings of around $350,000 annually in operating expenses of the parent company and subsidiaries have been effected. He expressed the hope that a plan of reorganization for the company, which has been in receivership since 1936, could be submitted to the court within the next 60 days.

Fees of $1,750 for the last half of March and $3,500 monthly thereafter were asked.

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SEC Approval Seen for Utility Issue

Approval was given this week of the application of New York State Electric & Gas Corporation for exemption from registration of a proposed $2,903,200 issue of 5 per cent, ten-year notes, as the Securities and Exchange Commission ended its hearing on Monday afternoon.

The notes have already been approved by the New York Public Service Commission and are to be sold in New York only. Proceeds are to be used to finance the business of the company.

At the hearing it was brought out that the utility prepares its balance sheet both on the reproduction-cost basis and on the historical-cost basis. On the former basis the utility's fixed capital account totals $125,000,000, while on the latter basis it amounts to $92,000,000, according to witnesses. The difference between these figures is carried as "excess reproduction cost," according to Clyde Weldin, a director of the company.

T. F. Rowe, treasurer of the company, stated he did not know which statement of the fixed capital would be used in the prospectus for the note issue, but added that he would find out.

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Utilities Power & Light

The annual meeting of stockholders of Utilities Power & Light Corporation has been adjourned to May 12.

Earnings Reports (Utilities)

	Net Income 1938	1937
*Southern California Edison	$11,740,921	$12,778,072
*N. Y. State Elec. & Gas	2,079,293	1,446,510
*Central Ill. Pub. Serv.	1,560,202	1,554,178
*Stone & Webster and subs.	732,989	1,098,937
*Minnesota Pwr. & Lt.	1,405,357	1,298,836
*Florida Pwr. & Lt.	2,152,680	1,498,095
*Utah Pwr. & Lt. and subs.	1,630,352	1,528,605
*Memphis Pwr. & Lt.	1,874,443	1,392,120
*Houston Ltg. & Pwr.	2,845,677	2,466,587
†Standard G. & E. and subs.	2,881,035	3,465,575
†Philadelphia Co. and subs.	7,348,944	7,826,321
†Duquesne Light	9,831,950	9,913,823

*Twelve months ended March 31.
†Twelve months ended February 28.

California Utility Has Record Year in 1937

Despite the loss of the large construction load at Boulder Dam, electric sales and revenue of the Nevada-California Electric Corporation set a new high in 1937, according to A. B. West, president.

Kilowatt-hour sales in 1937 were 319,726,275, against 290,852,309 in 1936, an increase of about 10 per cent. Electric revenue was affected by the loss of the Boulder Dam load which afforded a revenue of $270,492 in 1936; total electric revenue for 1937 was $4,925,386, against $4,922,243 in 1936. Revenue from residential or domestic sales, however, showed a gain of 14 per cent.

Commercial and industrial sales accounted for 46 per cent of the sales in 1937 and 47 per cent of the revenue; industrial sales made up about 31 per cent of the sales total. Total connected load was 265,156 hp., a gain of about 12 per cent; greatest increase was shown in residential, which gained nearly 30 per cent.

Sales of electrical merchandise also set a record in 1937, totaling $958,057, or an average of $38.99 per residential customer served, as against $595,211, or an average of $26.04 per customer, in 1936, a former record figure. Estimated annual revenue from appliances sold is $210,350. Appliance sales, including air heaters and small appliances, amounted to 11,111 in 1937, against 6,812 in 1936, and included 1,245 ranges, 874 water heaters and 2,356 refrigerators.

The interim contract for Boulder Dam power secured during the latter part of 1937 increased the company's hydro production to over 340,000,000 kw.-hr. for the year, the Boulder Dam allotment in 1937 amounting to 69,124,277 kw.-hr. Present precipitation on the corporation's watersheds and water now in storage assures another favorable water year, Mr. West stated.

Consolidated net income for the year was $732,977, against $866,824 in 1936, being affected by a decrease in operating profit of about 6 per cent. Increased operating costs incident to securing the new business, increased wage scales and added taxes were given as reduction factors.

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Grants Coffin Fellowships

Nine college graduates have been granted Charles A. Coffin fellowships, totaling $5,000 for use in carrying on advanced scientific research during the coming school year, General Electric Company has announced. The students will carry on their work in six different educational institutions, Massachusetts Institute of Technology, University of Chicago, Yale University, University of Cincinnati, University of Rochester and the University of Virginia. Five of the recipients of the fellowships are engaged in physics as their field of research, three in electricity and one in physical chemistry.

Des Moines Electric Light Company used this 1½-ton truck to raise the 75-ft. pole, all framed and ready for stringing, in constructing a 66-kv. insulated line. Heretofore 5-ton trucks were required for the job

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Booklet Describes Plastics

A new edition of the booklet "The Versatile Service of Bakelite Plastics" has just been published by Bakelite Corporation, New York. This sixteen-page booklet tells the history of modern plastics from the time of their discovery by Dr. L. H. Baekeland up to the present day. Copies may be had upon request.

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REA Begins Rural Survey

REA has begun a survey of Connecticut's rural territory to determine what rural lines should be extended. C. O. Falkenwale, director of the examining division, is in Hartford and is being assisted by Russell Cook and Peter Langhoff. Federal agents will seek meetings with co-operative organizations so as to get the public reaction as regards REA plans of rural electrification.

Grid Half Paid For, 1937 Report Shows

Five years after operations started Britain's "Grid" network has more than half paid for itself. This is the salient fact in the tenth annual report of the Central Electricity Board, recently issued. The cost of the Grid, including extensions and reinforcements to provide for new supplies and increasing loads, amounted to approximately £30,000,000 ($150,000,000). By the end of 1937 the total capital saving, it is estimated was approaching £17,000,000 ($85,000,000). The source of this saving has been mainly a reduction in the proportion of spare generating plant.

The other major economy was the revenue saving due to reduced coal consumption through concentration of production at more efficient stations—fifteen stations supplied more than 50 per cent of the total units generated for the board last year. There has been a progressive economy in average fuel consumption ever since 1932. Per unit it was nearly 17 per cent less last year than under the conditions of independent operation.

Total output of the public supply stations in Britain during 1937, the report states, showed the highest increase yet recorded. The figures were 22,905,000,000 units, an increase of 2,684,000,000 units over 1936.

Revenue credit balance from the board's operations last year was £2,014,508 ($10,072,540), compared with £1,686,944 ($8,434,720) for 1936. The balance of revenue carried forward was £1,761,431, which will be available, together with future income, to meet the interest and redemption fund charges.

Arrangements were made during the year with owners of selected stations in respect of extensions to their generating capacity for a total capital expenditure of £9,500,000, compared with £12,500,000 in 1936.

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Defers Electric Rate Probe

Further hearings in the Pennsylvania Public Utility Commission's inquiry into Philadelphia Electric Company's rate structure have been postponed and will probably not be resumed until some time in the last half of the year, Commissioner Donald E. Livingston stated. Resumption of hearings will await completion of three separate studies of the company's affairs now being conducted by the Federal Power Commission, the state commission and the company itself. The current trial reduction of $3,107,000 a year will be extended.

Engineering Council Plans Public Forum

The American Engineering Council is sponsoring a series of public forums on questions of the day, in which engineers and other professional men may meet with industrialists to discuss trends in national affairs with particular reference to specific problems.

For some time means have been sought of developing a wider public understanding of the relation of engineers to economic and social questions. The first step in this direction will be taken May 13, when the first forum will be held at the Engineers' Club in Philadelphia. The forum will discuss "Employment and the Engineers' Relation to It."

William L. Batt, past-president A.S.M.E. and president of SKF Industries, Inc., is chairman of the afternoon session. The program follows:

Greetings from engineers of Philadelphia —C. E. Bonine, consulting engineer, president Engineers' Club of Philadelphia.

Plan and Purpose of Forums of American Engineering Council—Frederick A. Allner, chairman AEC committee on public affairs, vice-president, Pennsylvania Water & Power Company.

Labor Policy and Prospects for Employment—Dr. Leo Wolman.

The Contributions of Technology to Employment—Leonard J. Fletcher, assistant general sales manager Caterpillar Tractor Company.

Evening Session

Chairman—Dr. William McClellan, president of American Engineering Council and president of the Potomac Electric Power Company.

AEC forum dinner, Engineers' Club.

Engineers, Economists and Politicians—Dr. Alexander Sachs, economist and director of research, The Lehman Corporation, New York.

Relation of Technology to Finance—William J. Kelly, president of the Machinery and Allied Products Institute and president of Arthur J. O'Leary & Sons.

Summary of the conference by Chairman McClellan.

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Dr. Rüdenberg to Address Harvard Engineers in May

Dr. Reinhold Rüdenberg, formerly chief electrical engineer of the Siemens-Schuckert Company and at one time honorary professor at the Technische Hochschule in Charlottenburg, Germany, and now with the General Electric Company in England, will give a series of three lectures on May 11, 12 and 13 before the Harvard Graduate School of Engineering.

The subjects will be: "Technique and Economy of Electric Power Transmission over Long Distances," "Oscillations Common to Synchronous Generators and Asynchronous Motors in Disturbed Networks" and "Straining of Machine Windings by Short-Circuit Forces and Traveling Waves. The lectures will be given in Room 110, Pierce Hall, Oxford Street, Cambridge, Mass., at 4 o'clock each day and are open to all interested persons.

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Puts New Stokers on Market

After four years of extensive research in the construction of stokers for anthracite coal, General Stokers, Inc., an M. A. Hanna associate, announced the "General" Stoker line. R. E. Chloupek, who has been in the stoker business for fifteen years, heads the new General Stokers, Inc., with headquarters in Philadelphia.

Meetings

Refrigerating Machinery Association — Spring meeting, Hot Springs, Va., May 11–12. Association headquarters, Southern Building, Washington, D. C.

National Fire Protection Association — Annual meeting, Atlantic City, N. J., May 9–13. A. R. Small, 207 East Ohio St., Chicago.

Empire State Gas and Electric Association —Electric operating group, Hotel Van Curler, Schenectady, N. Y., May 13. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

Northwest Electric Light and Power Association—Annual meeting, accounting and business practice section, Spokane, Wash., May 13–14. Berkeley Snow, executive secretary, 707 Spalding Bldg., Portland, Ore.

Air Conditioning Manufacturers' Association—Annual meeting, Hot Springs, Va., May 13–14. Association headquarters, 915 Southern Building, Washington, D. C.

National Electrical Manufacturers Association—Spring conference, The Homestead, Hot Springs, Va., May 15–20. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

American Institute of Electrical Engineers —Northeastern district meeting, Lenox, Mass., May 18–20. Summer convention, Washington, D. C., June 20–24. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

National Electrical Wholesalers Association —Annual convention, The Homestead, Hot Springs, Va., May 22–26. Alfred Byers, secretary, 165 Broadway, New York, N. Y.

National Association of Purchasing Agents —Annual international convention, St. Louis, Mo., May 23–26. Association headquarters, 11 Park Place, New York, N. Y.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 6–9. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Wisconsin Municipal Utilities Association —Annual convention, Marshfield, Wis., June 16–17. J. J. Jedwabny, secretary, Menasha, Wis.

Society of Chemical Industry — Annual meeting, Ottawa, Canada, June 20–22.

Canadian Electrical Association — Annual convention, Seigniory Club. Province of Quebec, Canada, June 22–24. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal, Que.

American Society for Testing Materials— Annual meeting, Chalfonte-Haddon Hall. Atlantic City, N. J., June 27–July 1. R. E. Hess, assistant secretary, 260 South Broad Street, Philadelphia, Pa.

Reorganized League Launches Program

With reorganization of the Electric League of Utah late in April, electrical dealers, jobbers, manufacturers, utilities and contractors will launch an active program of co-ordination. W. O. Smith, sales manager of the General Electric Supply Corporation, Salt Lake City, was named president of the league, succeeding W. A. Huckins. In addition to the regular slate of new officers, Elias Strong was named league manager. Formerly the organization functioned with an executive-part-time secretary.

More or less active for several years past, the league now plans a series of aggressive campaigns, the first of which will be adequate wiring, and through this campaign the public will be educated to approved wiring needs. Other officers named were G. W. Forsberg, vice-president, and Robert Nevins, secretary-treasurer. Among duties of the new manager are responsibility of effecting a complete representative membership from all branches of industry; to appear before any group whose interest could be developed and who might be connected with any type of building operation, and to develop a realization of the importance of adequate wiring in homes, mercantile institutions and industrial plants.

One of the first steps in the wiring program is address and discussion of the subject by Arthur Schanuel, member of the National Adequate Wiring Bureau, New York. It is expected that the league will also correlate sales and promotional programs which have wide interest in the electrical industry.

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Vote on Skagit Line Fails

Renton (Wash.) City Council failed to pass the ordinance which would have granted Seattle a franchise on a short route across the north end of the city to build the City Light Skagit transmission line. The vote was four to three for granting the franchise, but this fell one vote short of the five needed to pass a franchise ordinance. James Scavotto, president of the Seattle City Council, stated that the city will go ahead with its alternative plan of building the line around Renton.

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Dam Completion Date Set

Grand River Dam Authority has set January 1, 1940, as completion date for the $20,000,000 Grand River Dam and hydro-electric plant. The authority is rapidly acquiring the land necessary for the project.

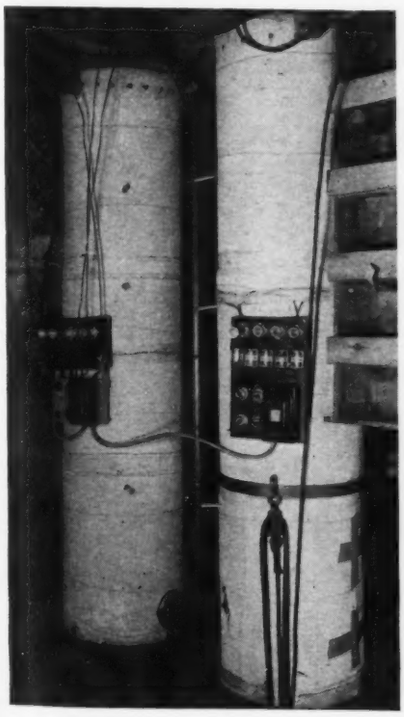
Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Melt Compound to Reclaim Bushing

By O. A. PENDLETON
Empire District Electric Company, Joplin, Mo.

Taking a compound-filled breaker or transformer bushing apart for repair or reclamation necessitates melting the compound out before disassembly is begun. An even heat, gradually increased to the melting point of the compound, is required in order to remove the compound without damaging the porcelain or bushing core and without approaching its flash point. Economical ovens have been devised by the Empire District Electric Company's reclamation shop.



Bushing ovens melt compound out

Each oven, used for either removing the compound or any moisture that may be present in the bushing core, is a very inexpensive, chimney type device made from old oil drums. Three drums, with both ends of two and one end of of the third, or bottom drum, cut out, were welded together end on end and sheet asbestos wrapped on the outside for insulation. Four, equally spaced, strip heaters were mounted inside the bottom drum. They are controlled individually by switches mounted on the outside. The temperature in the oven is controlled by these switches and thermometers are inserted in holes cut in the three drums.

Four chains of equal length, with hooks at their free ends, were attached 90 deg. apart and about two-thirds of the way down inside the top drum. The chains are of a length such that when hooked into the bolt holes of a bushing flange the bushing will be suspended upside down about midway of the oven. A bucket is attached to the lower end of the bushing to catch the compound as it melts out.

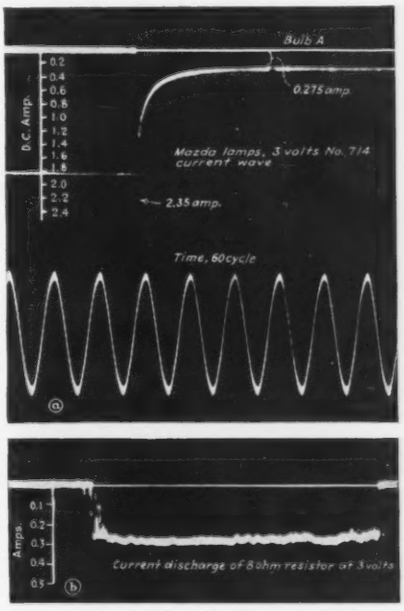
A loose-fitting cover is placed over the top of the oven and the heating units energized. Air is slowly but continually blown into the oven through a stove pipe duct by means of an ordinary fan placed in front of the duct opening. The amount of air required to maintain an even temperature over the entire bushing and to expel the moisture-laden air when drying a bushing core is regulated by the distance the fan is placed from the duct opening.

After the compound has drained out of the bushing the porcelain shell is removed and the core thoroughly cleaned of compound, after which it is again placed in the oven and heat and circulating air applied until any moisture that may have been in the core is removed.

•

Battery Life Tester Simulates Service

Prior to 1930 the Public Service Electric & Gas Company, Newark, N. J., used a commonly accepted laboratory life test for flashlight batteries used by meter readers and others. In this test cells or batteries were discharged continuously through a fixed metallic resistance of 4 ohms



Battery cells discharged through fixed resistance in accord with accepted laboratory life test

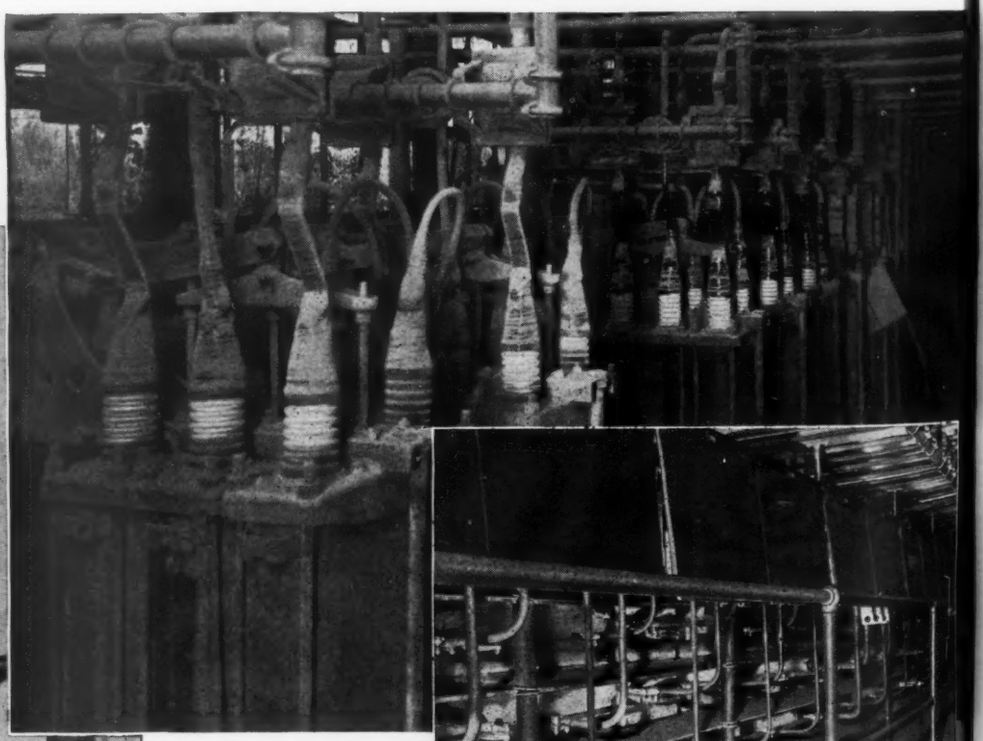
Results indicate longer life than service tests on cells discharged through flashlight lamp. Cold lamp filament draws about 2 amp. for 0.2 second (a) as against 0.3 amp. through fixed resistance. Heavy momentary current accounts for difference in life found in service and by test.

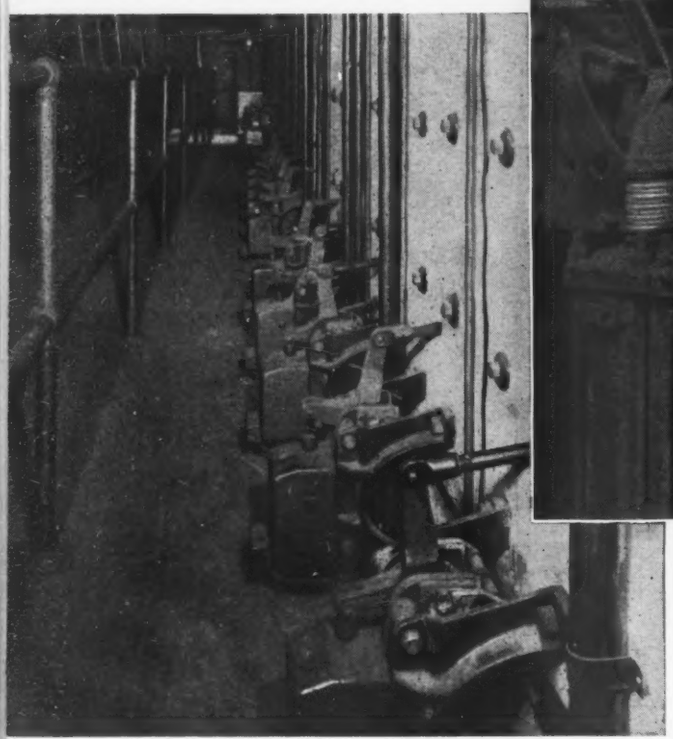
IT SEEMS
ONLY YESTERDAY

— *When This Was Standard Practice*

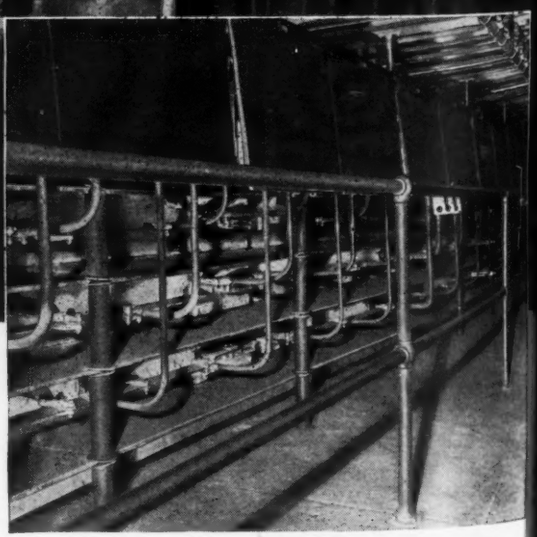
Exposed oil circuit breakers and connections

Breaker solenoid operating mechanisms exposed in the aisle





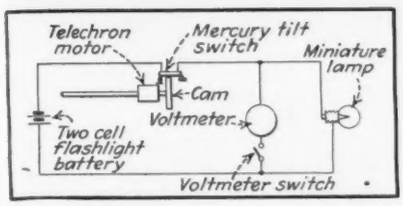
Exposed live bus sections — hook-operated switches above



This type of switchgear isn't adequate today

GENERAL

Filing No. 7300



Circuit duplicates service given flashlight batteries by meter readers

per cell at 68 deg. F. The test was considered complete when the closed circuit voltage fell below 0.75 volt per cell.

Checks on the life of batteries used for meter reading under normal conditions of use failed to agree with the laboratory tests. The use of a fixed resistance as a test load instead of an intermittently applied load from a miniature flashlight lamp was apparently the principal reason for this disagreement. The resistance of the lamp is approximately 8 ohms when hot, but its cold resistance is only 1 ohm. As shown in the accompanying oscillograms, the battery has to supply a current of approximately 2 amp. for a period of one- to two-tenth seconds when discharged through the cold lamp, as against 0.3 amp. when discharged through the metallic resistance. For any considerable number of flashlight operations this will affect the life of the battery.

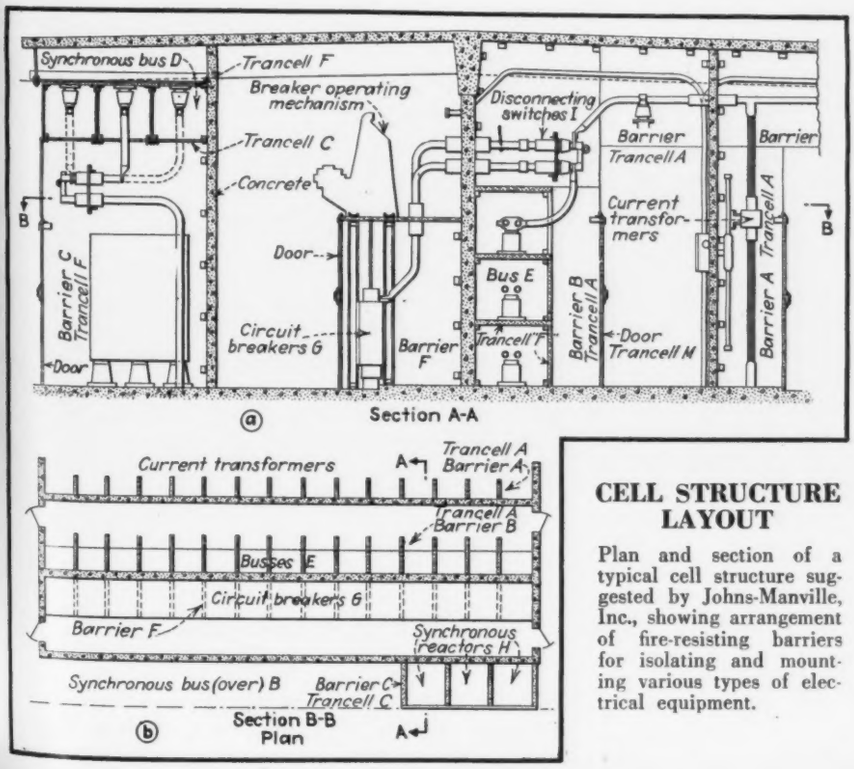
A field investigation checked this point and in addition indicated that the cut off point of 0.75 volt was too low. This should be raised to 0.825 per cell. In a field investigation covering 20,000 meter readings in rural and city districts it was found that the meter reader's flashlight was operated in average cycles of one minute discharge and two minutes of rest or recuperation over a period of 5½ hours a day.

Based on the results of the field investigation a test method was developed, differing from the former method as follows:

Selected miniature lamps were substituted for the fixed resistances and a cycle of one minute discharge through a miniature lamp and two minutes rest or recuperation was adopted instead of the continuous discharge through a fixed resistance of 4 ohms. Only lamps which have a current consumption of from 300 to 310 milliamp. at a voltage of 2.6 are used and a new set of lamps must be used for each test. The test is considered complete when the closed circuit voltage has dropped to 0.825 volt per cell.

In the test equipment now in use a gang of twelve mercury tilt switches, one for each two cells, is operated by a telechron motor through a cam to produce the proper cycle of on and off operation (see Fig. 3). Closed-circuit voltage of each set of cells is read every half hour with a d.c. voltmeter having a range from 0 to 3 volts and a resistance of at least 100 ohms per volt.

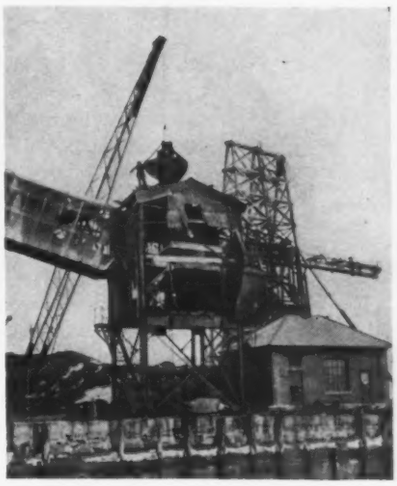
Random cells from all large shipments received by the company are tested for compliance with the manufacturer's guarantee. The results by this test method check with the service life in the field, and since the change from the old to the new test method the manufacturers have improved the quality of the batteries so that a discharge life of 1,000 minutes or more is obtained as against 250 to 400 prior to 1930.



CELL STRUCTURE LAYOUT

Plan and section of a typical cell structure suggested by Johns-Manville, Inc., showing arrangement of fire-resisting barriers for isolating and mounting various types of electrical equipment.

Crane Supplies Coal After Dock Fire

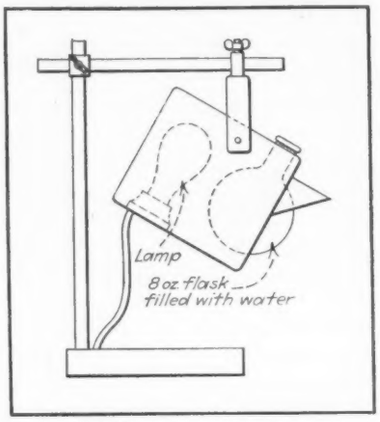


Following the recent destruction of much of the coal-handling plant outside its generating station by a dock fire, the Lynn Gas & Electric Company made emergency repairs to the junction tower shown in this view, installed about 500 ft. of new 24-in. conveyor belt in the galleries feeding the overhead bunkers, replaced a wrecked conveyor motor by a new 25-hp. machine and substituted a tractor crane with a 60-ft. hoist for the previous method of delivering coal to the junction tower. Formerly coal was hoisted from vessels moored alongside the company's 600-ft. dock by two traveling towers, which either discharged the fuel into the storage area bordering the waterfront or delivered it to a belt conveyor which terminated at the junction tower, whence conveyor belts carried it to the gas plant or to the electric generating station as required.

The amount of coal in yard storage at the time of the fire was large enough to enable the company to operate its plant without service interruption and for the present without water deliveries. A gasoline truck was pressed into service to collect steam coal from various points in the yard and to discharge it on the ground near the junction tower. The tractor crane transfers a bucket load from the pile every 53 seconds to the junction tower hopper, and so feeds the belts serving the boiler house bunkers with regularity. It is noteworthy that a Merrick weightometer in this coal supply line went through the fire with so little damage that it resumed service soon after inspection.

High Intensity for Jewel Inspection

Light of high intensity is required for microscopic examination of meter jewels, yet the light on the jewel surface should be well diffused, not focussed. In the meter department of the Union Electric Company of Missouri in St. Louis is a simple



Water lens lantern

lighting unit that well answers this purpose. As shown in the accompanying sketch, the unit is a rectangular lantern containing an incandescent lamp, in front of which, and acting as a lens, is an 8-oz. laboratory flask filled with water. With this unit the intensity of light on the jewel surface is not a matter of focussing but of putting enough light production behind the water lens to get the amount of illumination desired on the jewel.

•

Protect Operators Against Flashovers

As a protection against possible painful burns from flashovers occurring during switching operation, substation operators of the Dayton Power & Light Company are now equipped with protective chrome tan fire-resisting leather coats and horn fiber skull caps. A group of men in this protective clothing is shown in the accompanying illustration.

Coats are made with a close-fitting military collar, fastened in front with conventional buckles and extending well below the knees. The horn fiber skullcap does not touch the head, but is supported by a head band and cross straps, adjustable to fit the wearer. Over this cap a leather cowl of the same material as the coat drops down to the shoulders, protecting against any exposure to the neck and head. The hoods are provided with a heavy non-breakable hinged glass panel in front.

The helmet and coat, together with rubber gloves and protective leathers, make an effective guard against the possibility of a flash igniting the clothing. Co-operating in the design of the new clothing was P. G. Mitchell and C. E. Gebhart of the system operating department, G. A. Doeller of the accident prevention committee and R. H. Krone of the Cincinnati Gas & Electric Company.

Leather clothing prevents flashovers from igniting clothing of substation operators engaged in switching

Men are shown holding "Glotectors," neon tube devices for the detection of energized conductors and switch clips.

Secondary Distribution Economics *

II—Voltage Drop and Transformer Size

By E. M. ADKINS
Jersey Central Power & Light Company

The voltage drop, $V = \frac{T^2 Dz}{8{,}000}$ volts is based on the assumption of a uniformly distributed load. It is found that the voltage drop for a load evenly distributed per pole or span length is 1.2 times as great as for a load distributed uniformly along the length of line.

In addition, if voltage drop is calculated for one condition of load and then calculated again with the transformer moved one span away, it will be found that the voltage drop may be increased more than 50 per cent if the transformer is one span off center. Also, it will be found that the load per pole will vary somewhat and that it will be impossible to divide the load exactly equal per leg. All of these factors tend to increase voltage drop. If the reasonable assumption is made that these additional factors will further increase the maximum voltage drop for the average secondary circuit by 67 per cent, the total increase in voltage drop over the ideal circuit is 1.2 x 1.67 = 200 per cent. The expression previously developed for voltage drop should, therefore, be doubled so as to satisfy conditions for the average circuit. The revised equation for voltage drop is equal to the following:

$$V = \frac{2T^2 Dz}{8{,}000} = \frac{T^2 Dz}{4{,}000}$$

The total length of secondary circuit in feet may be found from the equation for voltage drop as follows:

$$T = \sqrt{\frac{4{,}000V}{Dz}}$$

The transformer load current in amperes is equal to the following:

$$I = \frac{TD}{1{,}000} = \frac{D}{1{,}000}\sqrt{\frac{4{,}000V}{Dz}} = \sqrt{\frac{4{,}000DV}{z\times 10^6}}$$

$$= 2\sqrt{\frac{DV}{z\times 10^3}}$$

* Installment No. 3 in a series to continue in forthcoming issues of ELECTRICAL WORLD.

R&IE Indoor Switches

LESS OPERATING RESISTANCE

Hi-Pressure Contact Jaw and Hinge eliminate large blade contact surfaces which cause friction when blade is operated in or out of contact, especially after standing idle.

LESS CURRENT RESISTANCE

Hi-Pressure Contacts at jaw and hinge have clean concentrated spot (in jaw) or line (in hinge) contact areas under pressure, which are more efficient, more positive and free from resistance.

LESS SPECIFICATION RESISTANCE

Hi-Pressure Contacts have been successful in giving years of trouble-free service under all conditions, making them desirable on switching equipment being specified daily.

ARE YOU GETTING THE ORIGINAL, PROVEN HI-PRESSURE CONTACT ON YOUR SWITCHING EQUIPMENT...?

STREAMLINED-for Effeciency and appearance

RAILWAY and INDUSTRIAL ENGINEERING CO....GREENSBURG, PA.

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Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

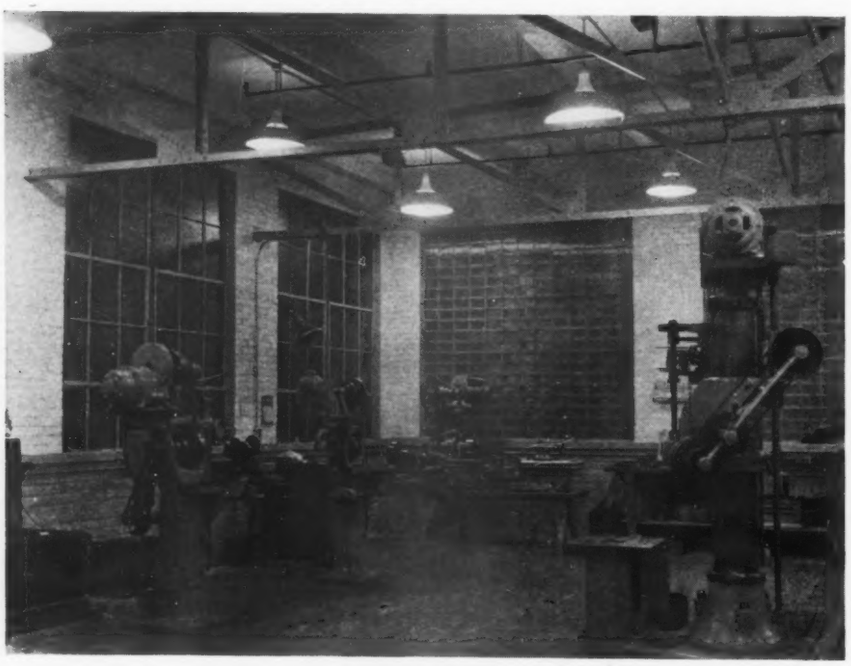
Intense Light Insures Accuracy

By HORACE W. MYERS
Lighting Engineer
Central Massachusetts Electric Company,
Palmer, Mass.

Tolerances allowed by the A. B. & J. Rathbone Company, Palmer, Mass., are often as close as plus or minus 0.0001 inch, and because the finished product (pinion and special shaped wire used by manufacturers in the production of clocks, refrigerator controls, etc), cannot be more accurate than the tools and dies used in drawing the wire, it is especially important that the machine shop where these tools are made be illuminated to a degree where easy and accurate seeing is possible.

For the past two years this company has had several combination units of the 250-watt-mercury-300-watt tungsten type at points throughout the plant and thus was acquainted with the characteristics and increased efficiency of mercury-tungsten lighting. Last November, when a new and larger machine shop was built, the owners decided to equip it with a mercury-tungsten lighting system capable of providing approximately 50 ft.-candles of general illumination with "plus lighting" furnished at certain points by means of localized equipment. The shop being 34x40 ft., it was decided to use eight 400-watt high-intensity mercury and eight 300-500-watt tungsten units in Glassteel diffusers staggered on 9x10-ft. centers and mounted at 12 ft. above the floor. The resultant light intensity at 4 ft. above the floor, one month after installation, with 300-watt lamps used in the tungsten units, was 52 ft.-candles maximum, 43 ft.-candles minimum and averaged 47 ft.-candles. The system gives a high level of even illumination, with total absence of glare.

An intensity of 165 ft.-candles of localized lighting is built up on certain machines by means of 200-watt tungsten units located over the work. All lighting equipment was that of the Benjamin Electric Manufacturing Company, Des Plaines, Ill.



Machine shop general lighting requires 5,600 watts to supply 48 ft.-candles for accurate production
Supplementary units deliver 165 ft.-candles on certain machines.

•

Timed Controls Cut Water Pumping Costs

Reduced operating costs have been achieved by the Riverside Water Company, a customer of the Nevada-California Electric Corporation, through the recent application of electric controls to several 150-hp. deep-well pumping plants. The Riverside Water Company operates 20 miles of irrigation canals serving farm customers from Colton to Corona, Cal. Since farmers may take water after 24-hour notice, considerable night patrolling and extra-time plant operators formerly were required to start and operate the different plants at odd hours.

First step toward automatic control was taken by A. A. Webb, engineer for the water company, when he designed the portable time control shown in (a). It consists of a 440/110-volt current transformer, relay and time clock. This device was effective in automatically starting and stopping across-the-line motors at preset hours and in disconnecting the older belt-operating motors with compensators.

When seven new plants were added

Cut Costs!
. . . with the FUSTAT

if you

SELL *appliances*

SERVICE *appliances*

or

INSTALL *appliances*

Permits adding more Appliances to present Circuits

You can load an ordinary circuit right up to capacity and yet protect it with a 15 ampere Fustat. Its long time-lag keeps it from opening needlessly as when motors start on washing machines, oil burners, refrigerators and other appliances.

Thus you can expand the use of present circuits with perfect safety — and without incurring needless blowing of fuses.

Abolishes aggravating "Blown-Fuse" Service Calls

Such calls are wasteful and costly to everybody.

The user loses time and temper and often money when service is off.

The service man is dragged away from more profitable work.

Contractor or dealer loses if user kicks about paying full cost of a call where the only work done was to replace a blown fuse.

The Fustat stops such senseless waste because it doesn't blow needlessly.

Protects against Dangerous Overloading of Circuits

The Fustat cannot be replaced with a penny or other substitute for the fuse — or with a size too large to protect.

The user is protected against anyone unwittingly creating a fire or personal injury risk thru haphazard practices that permit circuits to be overloaded. Once installed, SAFE protection REMAINS SAFE.

If additional circuit capacity is needed, users cannot readily side-step the issue — at the sacrifice of safety.

Prevents Hazardous Burnout of Flexible Cords — in Spite of Long Time-Lag

The Fustat contains a fuse. The ability of a fuse to protect against dangerous cord shorts, grounded sockets, etc., is well known.

The quick action of the Fustat on such dangerous "household shorts" prevents spraying of molten metal, starting of fires, burning of users.

Helps reduce User Kicks about Service or Appliances

Users "just can't be made to understand" why other protective devices often open when there is nothing wrong.

When such needless shutdowns occur with newly purchased appliances they get particularly "hot" and generally throw the blame on whomever sold or installed the appliances.

Such user complaints hurt not only the dealer or contractor — but everybody in the Electrical Industry.

The Fustat offers a common sense way to reduce this evil to a minimum.

It's just good business to sell, install and use Fustats.

Fits present fuseholders

Thru the use of an inexpensive adapter that locks in place, the Fustat fits in any standard Edison base fuseholder.

On new jobs, you can specify that panels, switches, etc., be equipped with Fustat bases.

Retails at 7½c

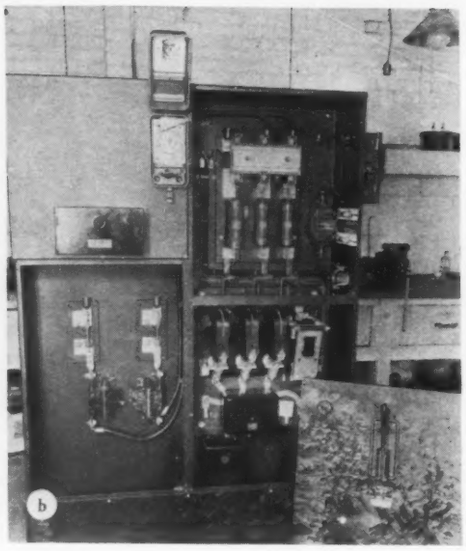
Retails at **7½c** in 15 to 30 amp. sizes

The FUSTAT

For full information write to any of these Firms

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Mo.
JEFFERSON ELECTRIC CO., Bellwood, Ill.
KIRKMAN ENGINEERING CORP., 121 Sixth Ave., New York City
NATIONAL ELECTRIC PRODUCTS CORP., Fulton Bldg., Pittsburgh, Pa.
UNION INSULATING CO., 277 Broadway, New York City

(a) The box is hung on the motor-starter cabinet, connections being simply made by means of the connector in foreground. The plug on the right side of the box is removed and inserted in the motor starter. Made of fibre, it carries a conducting tip which slides between starter contactors.
(b) Control assembly for completely automatic plant.



Portable automatic control for manual pumping plants

to the lines cabinet-contained automatic control (b) was installed in each. Switch, fuse, current coils and space for the power company's meter and test lugs were provided in the cabinet by the manufacturer. To this was added the current transformer, fuses, time-delay relay, time clock, transfer switch (for converting from automatic to manual operation) and the hold button (to keep plant operating during change-over from manual to automatic operation, or vice versa).

The time-delay relay is necessary because the plants are water lubricated. The relay holds the motor off the line while the water valve is opened, admitting the 50 to 100 gal. of water which the plant requires for operation.

•

Warming Oven Cuts Production Expense

By E. A. DEAN
Plant Superintendent
Panelyte Corporation, Trenton, N. J.

To be easily formed without breakage bakelite must be heated to a temperature of the order of 100 deg. F. At the Trenton plant of the Panelyte Corporation this was done formerly by passing the strips over a steam table adjacent to the punch press on which they were to be formed. The operation was costly because it required the attention of two operators, one to keep the table loaded and another to pass the heated strips to the punch press operator. In addition, the strips were not heated to a uniform temperature.

Consequently a small, low-temperature, automatically operated electric warming oven was designed to replace the steam table. This 7-kw. oven now delivers the strips to the punch press operator one at a time as needed and at the correct forming temperature. Three banks of ten 600-watt, 110-volt heaters in series connected in parallel across 480 volts are arranged on the top and bottom of the heating chamber through which the strips pass on a chain actuated by the stroke of the punch press. As each strip is stamped in the press a heated strip is ejected from the oven at the operator's elbow ready for punching.

Since the oven is provided with a magazine, one operator can now easily keep a large bank of ovens charged. By arranging the equipment so that the press operator removes the heated strips from the oven the operator that formerly performed this task is released for more productive work.

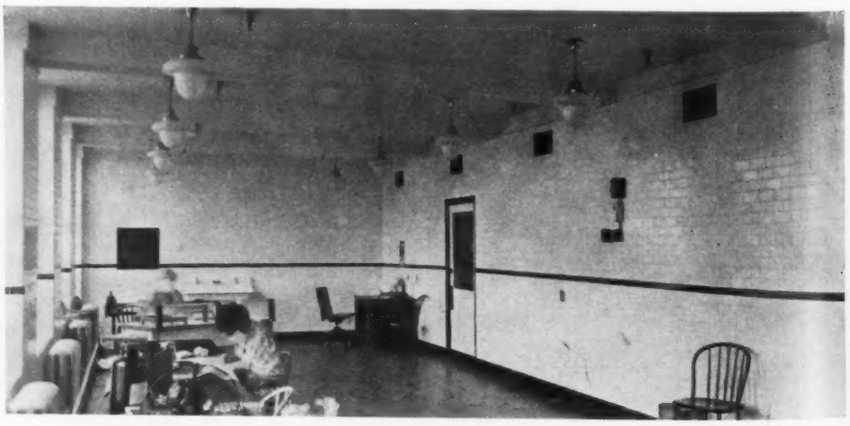
This oven, which is supplied from the lines of the Public Service Electric & Gas Company, consumes about 50 kw.-hr. a day on full-time production. This represents an energy charge of about $0.70.

•

Clean Air Vital to Drug Industry

Quality and accuracy in compounding materials for medical use are dependent on close temperature regulation, controlled relative humidity and cleanliness of atmosphere. At the Boston plant of the United Drug Company air conditioning is in the forefront of this picture. From two 50-ton ammonia compressor units ammonia is circulated to six major conditioning centers where automatic units serve local needs. The Boston Edison Company's circuits serve the plant.

A typical application in the plant is in the so-called "Hypodermic Room," shown. This room is 50 ft. long by 18 ft. wide by 12 ft. 6 in. high, designed for maximum sanitation, and furnished with air washed and held at 72 deg., with relative humidity of 30 per cent. Tablets hand-molded under these conditions are uniform as to quality and make-up. The air-conditioning unit here is equipped with a 0.5-hp. motor-driven fan, spray washer, ammonia coils, a glass wool filter and steam heating coil. From the air-conditioning unit the air is led by duct line to six inlet grilles near the ceiling, and thence discharged into the room.



Hypodermic room, where tablets are molded in conditioned air

COPPERWELD

Guaranteed

COPPER THICKNESS

—and what it means to you

THE copper thickness on Copperweld wire is accurately measured and guaranteed. It must be not less than 12½ per cent of the wire radius of 40 per cent conductivity wire, and not less than 10 per cent of the wire radius of 30 per cent conductivity wire.

That means long life, freedom from rusting and lowered maintenance costs, when you use Copperweld wire or strand for guys, messenger cable, overhead ground wire, telephone wire, signal line wire, rail bonds, fence, etc.

It means that Copperweld can be clamped, bent, served, twisted or spliced without injury to the thick protective covering of welded-on copper.

You can have all the advantages of Copperweld's guaranteed copper thickness and permanent high strength for surprisingly little. Seldom does the use of Copperweld add more than a few per cent to the total cost of the job.

You are invited to write for a copy of Specification BW35, which includes complete specifications and guarantee.

COPPERWELD STEEL COMPANY

Glassport, Pa.

COPPER · BRONZE · COPPERWELD RODS, WIRE, AND STRAND

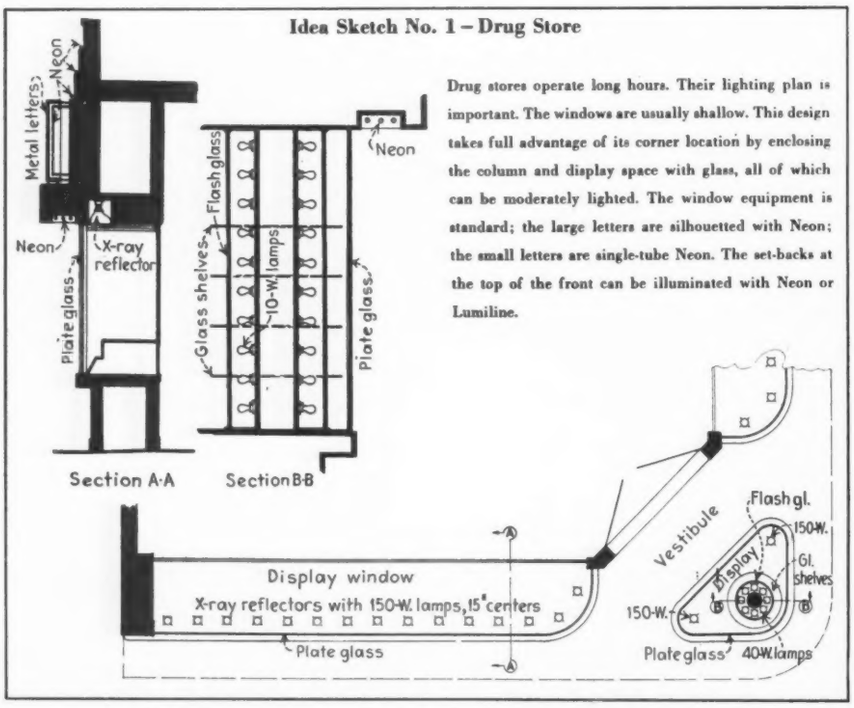
Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Idea Sketches Used To Build Lighting

Commercial lighting load and revenues are not only being maintained but are being steadily increased in the San Francisco Bay territory of the Pacific Gas & Electric Company by an intensive sales drive based primarily upon the forthcoming Golden Gate International Exposition. Pointing out that $250,000,000 will be spent by exposition visitors in 1939, commercial lighting sales engineers are emphasizing the value of modern lighting as a sales magnet for increasing business.

The sales campaign is built around an elaborate direct mail brochure which describes the fair, shows what happened in Chicago, Dallas and San Diego, analyzes anticipated expenditures and then launches into a lighting sales story. Leads from this direct mail piece are followed up by lighting salesmen, who offer the services of the company's planning division. This department prepares idea sketches, most of which are based on store front modernization and interior lighting. Various classes of businesses are worked in rotation. The start was made with drug stores, and food markets, beauty parlors, restaurants and other establishments will follow in order to help the company cash in on the fair.


Idea Sketch No. 1 – Drug Store
Drug stores operate long hours. Their lighting plan is important. The windows are usually shallow. This design takes full advantage of its corner location by enclosing the column and display space with glass, all of which can be moderately lighted. The window equipment is standard; the large letters are silhouetted with Neon; the small letters are single-tube Neon. The set-backs at the top of the front can be illuminated with Neon or Lumiline.
Metal letters
Neon
Neon
X-ray reflector
Plate glass
Flash glass
Glass shelves
10-W. lamps
Neon
Plate glass
Section A-A
Section B-B
Display window
X-ray reflectors with 150-W. lamps, 15" centers
Plate glass
Vestibule
Flash gl.
150-W.
Display
Gl. shelves
150-W.
Plate glass
40-W. lamps

Typical idea sketch used by Pacific Gas & Electric Company lighting engineers in selling commercial lighting

Water Systems Help Farmers Make Money

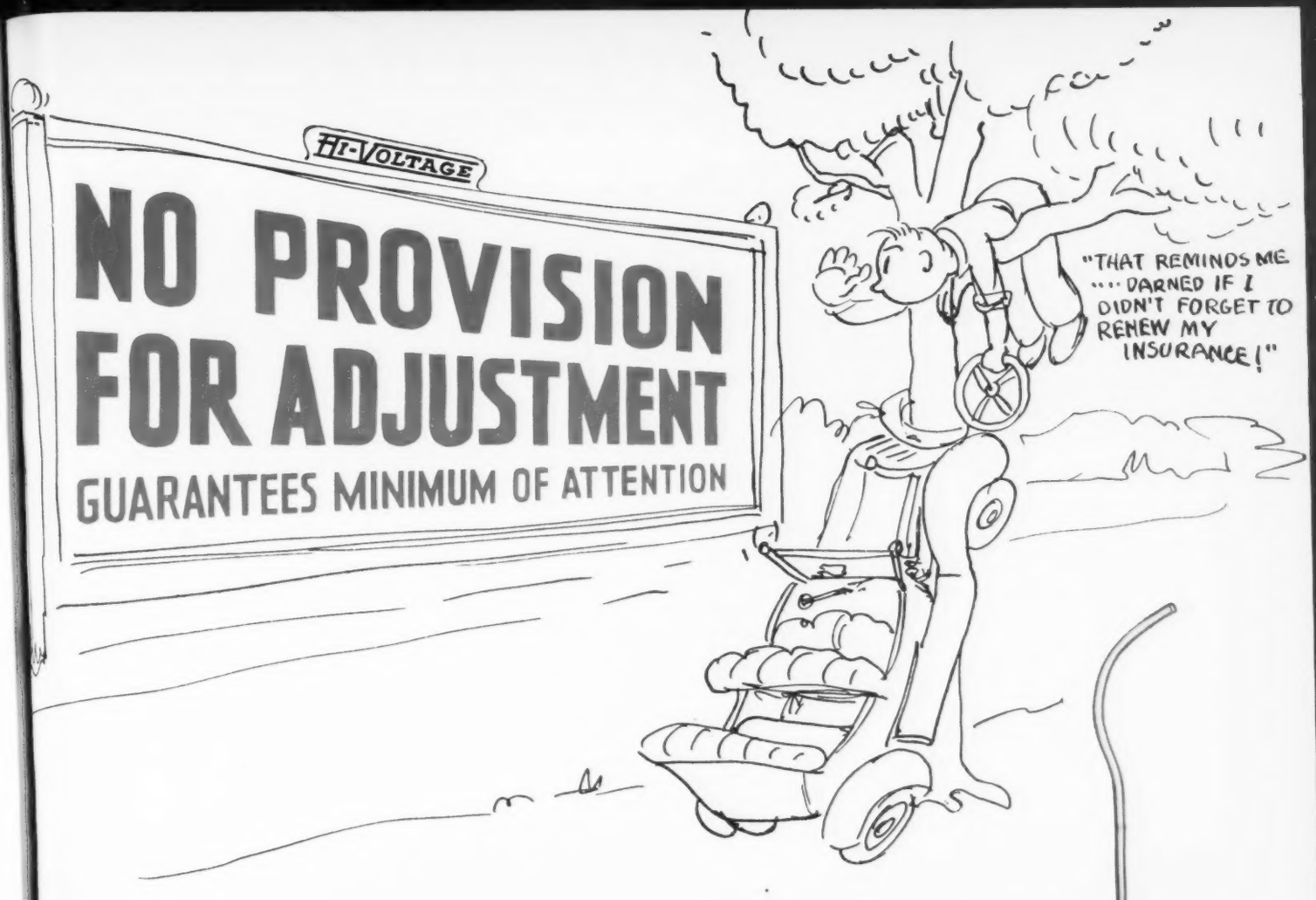
Electric water systems help farmers to make money. They are also an important factor in raising the farm standard of living. That is why the electric water system is usually the first electrical improvement, with the exception of electric lights, that the farmer installs when electric service becomes available, according to Harris E. Dexter, chairman of the Electric Water Systems Council of Edison Electric Institute.

Murray Wigsten, an up-to-the-minute farmer near Poughkeepsie, N. Y., presents convincing proof of these statements. "Running water means more money to the farmer, more milk per cow, more eggs per hen, more apples per tree, more beef per steer, more strawberries and raspberries, more vegetables from the garden.

"Farmers spend their money freely," he says, "but they have certain very definite ideas as to how they will spend it. They simply will not hitch the cart before the horse. In their minds an additional bridge lamp or an electric range before they have water under pressure puts the cart decidedly before the horse.

"This is right thinking. You can't be sold a $300 living room rug when your kitchen needs linoleum, and no 'hurrah, boys' campaign ever devised can sell right-thinking farmers all-electric kitchens, electric cooking, student lamps or toasters until 'Chick Sale' is on the wood pile and the cows no longer drink at the creek.

"On my farm, which is not large, we keep 20 cows and 400 to 500 hens. We grow crops to feed them


HI-VOLTAGE
NO PROVISION FOR ADJUSTMENT
GUARANTEES MINIMUM OF ATTENTION
"THAT REMINDS ME .... DARNED IF I DIDN'T FORGET TO RENEW MY INSURANCE!"

So simply designed and accurately machined is the operating mechanism of Hi-Voltage Air Break Switches that there is never any occasion for making adjustments in the field. In fact no *provision* for adjustment will ever be found on Hi-Voltage Equipment . . . another evidence of the more reliable, cost-freer operation we have actually *built* into Hi-Voltage Equipment. But *don't* expect to pay extra for this better performance . . . Hi-Voltage Switches cost you no more in the beginning and will save you money ever after.

Ask for a copy of Bulletin 26.

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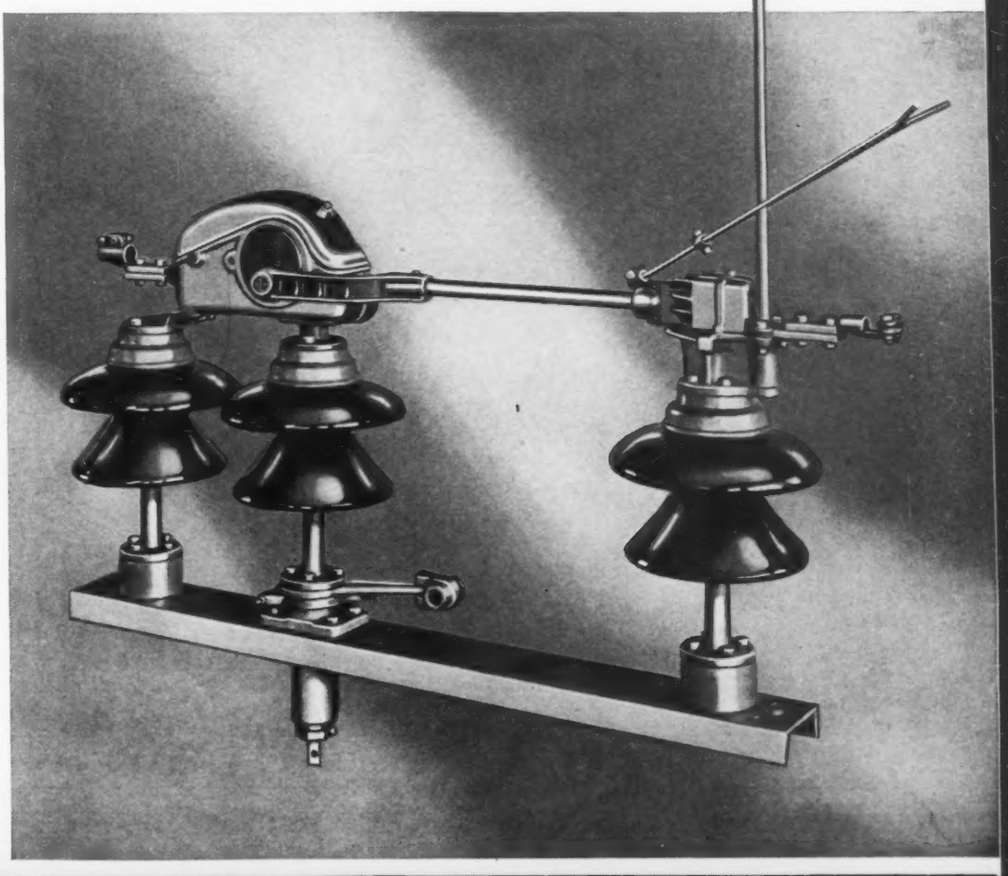


HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH ST., CLEVELAND, OHIO

and some to sell. With our modern equipment, one man does all the work.

"But suppose we take away the water system—what then? It would take five hours, every day including Sundays—35 hours a week—just to pump and carry the water. That is a whole week's work to some minds. But suppose it is only half a week's work. These farm men cost, with privileges, about $20 a week. That would be $10 a week to pump and carry water! Forty dollars a month! Forty dollars a month would buy the complete electrical equipment for any farm!

"That isn't all. My cows give 15 per cent more milk because they have water in the barn, and the hens lay more eggs with water always before them. I don't know so much about hogs and beef, but common sense tells me plenty of water will add plenty of pounds to them also.

"As a farmer I would like to suggest that more than water comes into a farmer's system when he takes the first cool drink from his new electric water system. He gets an inspiration to modernize and electrify that no other appliance he ever buys will bring him. It pays him big profits, and it makes the next step look easy to him," Mr. Wigsten concludes.

•

Written Proposals Help Power Sales

By GEORGE H. WECKEL
Kansas Gas & Electric Company, Wichita, Kan.*

Conclusive proof of the value of written sales proposals come from information on power sales experience contributed by member companies of the Missouri Valley Electric Association. Out of a total of 46 cases of threats to existing loads reported, 31 were handled with and fifteen without written sales presentations. In nine of the cases where written presentations were made the business was lost, or a mortality rate of 29 per cent. Where written presentations were not made five jobs were lost, or a mortality rate of 33 per cent. Out of 23 negotiations for isolated plant loads using written proposals, 20 were successfully closed, or a score of 87 per cent. Out of nine negotiations where written proposals were not made seven were successful, or a score of 77 per cent. Additional credit can be taken for written sales proposals, when consideration is given to the fact that most of the cases where written proposals were made the threats were more serious, the negotiations more involved and more strongly competitive than in those cases where no written presentations were made.

The value of written sales proposals lies not only in the fact that the power salesman can use a written presentation to back up his verbal sales talks and conferences, but he can better place his arguments before those in the customer's organization who are likely to be interested in the proposition as well as before his own executives as a measure of his efforts to combat the competitive threat. A salesman cannot ordinarily see all of the individuals in the customer's organization who are likely to be interested in or affected by the proposal. The following possibilities indicate a need for the written report:

Analysis by customer's plant superintendent, engineer or manager, who will, of course, be thoroughly familiar with the mechanical details of the installation.

Analysis by the consulting engineer on the job, who also has a detailed knowledge of the situation.

Analysis by the customer's general office or controlling company, which may not be so conversant with all mechanical details and which would, therefore, require certain facts and descriptions of detailed operations.

Final analysis by chief executive, who must authorize the cash expenditure and who will look at the capital outlay more from a banker's viewpoint than as an operator.

It is also desirable to make a written presentation whether or not it is ever to be used with the customer. This is true because an adequate written sales presentation results automatically in the utility salesman becoming thoroughly familiar with his subject, so that in his selling efforts he does not miss any points which will be useful to him in obtaining the business.

Gives the salesman more confidence in, and a greater appreciation of, the value of utility services, because of the complete study and review necessary for him to make before he can prepare a worth-while sales presentation.

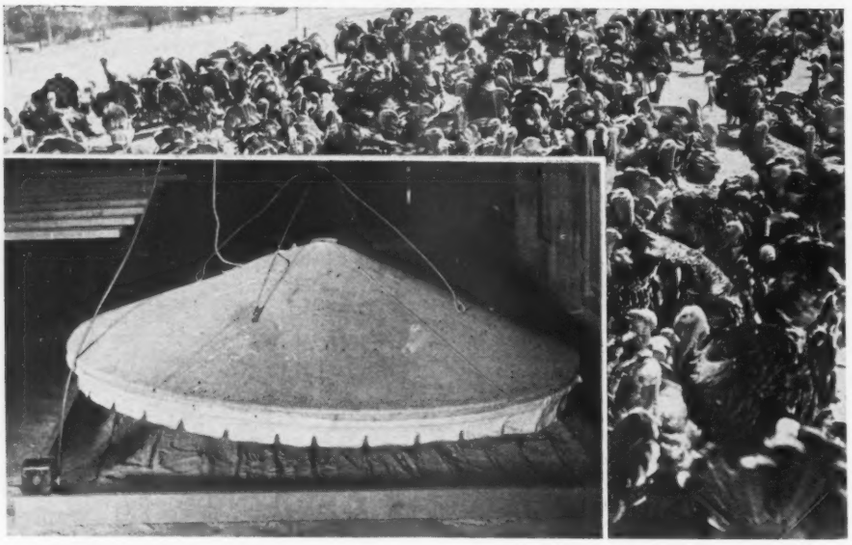
Affords a means to present to the customer or prospective customer a complete summary of all previous discussions if that appears advisable.

Results naturally and almost mechanically in the preparation of planned interviews based on logical thinking and arrangement of points to be made, so that the salesman may follow such logical treatment of his subject when face to face with his prospect.

Eliminates possible subsequent misunderstandings with the customer which might otherwise occur.

* Adapted from paper to Power Sales Conference, Missouri Valley Electric Association.

UNDERHEAT, FORCED DRAFT, COMBINED IN BROODER



Practice in raising poultry has usually been to employ either a regular forced-draft ventilation brooder or underheat provided by soil-heating cable buried in sand. The Prikett ranch, near Moorpark, Calif., however, uses a combination of the two systems. As illustrated, a square, boarded inclosure slightly wider than the diameter of the forced-draft brooder is laid over a sheet of tar paper. Then placed in the inclosure in order are 3 in. of sand, 75 ft. of soil-heating cable laid in loops 6 in. apart and 2 in. of sand. A thermostat maintains the temperature at 70 deg. F. Provided by the forced-draft brooder is essential ventilation and fresh warm air; by the soil-heating cable, an even temperature gradient which prevents crowding. Result of the set-up is reduced mortality and hundreds of toms like those above.

THE WIRE THAT MADE ELECTRIC HEAT POSSIBLE ★

ELECTRIC HEAT AT ITS *Best* ★ CHROMEL

Heating Chromel HEATING ELEMENT WIRE *Element* WIRE

When a heating device has Chromel elements, its user soon becomes aware of how advantageous electric heat can truly be. Electric heat at its best is made possible by heating-elements of Chromel.

HOSKINS MANUFACTURING COMPANY • DETROIT • MICHIGAN

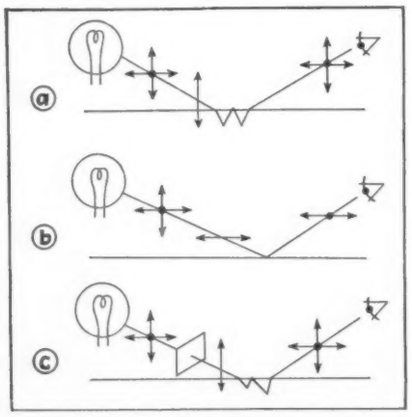
New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Lamp Cuts Glare by Polarizing Light

With the application of a light-polarizing substance to a new desk lamp design, Polaroid Lighting Inc., West Haven, Conn., has made a new approach to the attainment of glareless local illumination by blanking out the glare-producing horizontal components of light at their source.

"Polaroid," the polarizing material used in the new lamp, is a transparent plastic sheet in which tiny crystals of iodo-sulphate of quinine have been so oriented that their optical axes are in practical alignment. In this condition the crystals have the property (like that of the classical Nicol prism) of passing only light waves that vibrate in the plane of crystal alignment. All other wave planes are blanked out.



How polarized light eliminates glare

Vertically vibrating light (a) when it strikes the working surface penetrates and comes to the eye as a diffused light giving an impression of color, contrast and texture. Horizontally vibrating light (b) glances off the working surface practically unchanged and hits the eye as glare. A polarizing substance such as Polaroid at the lamp (c) filters out the objectionable horizontal component, passing only the useful vertical vibrations.

Light waves in ordinary diffused light vibrate in all planes at right angles to the direction of the light beam. Waves vibrating in the vertical plane strike the reading surface, penetrate and come to the eye as diffused light that gives the impression of color and texture of the surface. Horizontally vibrating waves do not penetrate, but glance off the surface without change and come to the eye as glare or specular light. In the new lamp light from the bulb is passed through a vertically oriented sheet of transparent Polaroid, which removes the objectionable horizontal waves that cause the reflected glare, letting only the useful or "seeing light" reach the eye of the observer.

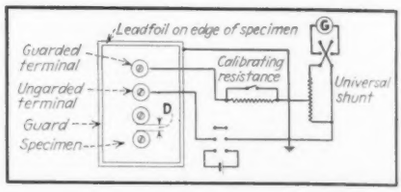
•

Do Terminals Affect Insulation Values

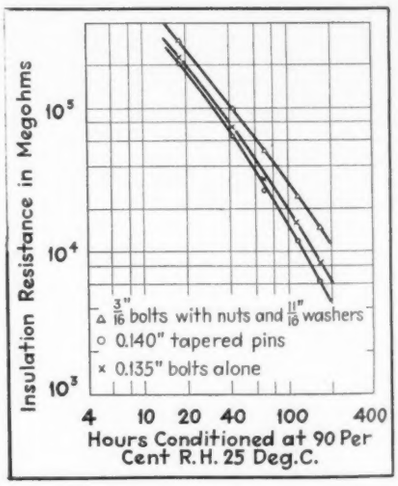
By GERARD A. ALBERT
National Vulcanized Fibre Company, Wilmington, Del.

Tests to determine the effect of terminal size, shape and spacing on the insulation resistance of phenolic sheet materials exposed to humid conditions for varying lengths of time lead to the following general conclusions: (1) Size of tapered pin terminals has little effect on the measured values; (2) degree of contact a terminal makes with the inner wall of a hole in the specimen has little effect; (3) measured insulation resistance between tapered pin terminals or between bolt and nut terminals with washers is proportional to the spacing of the holes drilled in the specimen.

Four different types of terminals were examined: (a) Standard $\frac{3}{16}$-in. bolt and nut with $\frac{3}{16}$x$1\frac{1}{16}$-in. washers; (b) bolts having a diameter of 0.135 in. inserted in holes of about



Circuit arrangement for measuring insulation resistance of guarded specimens between different types of terminals



Resistance of sheet insulation varies with type of terminals used and time of exposure to moisture

Note that resistance between the tight-fitting tapered pins and between bolts alone (which make contact at thread edges only) is substantially the same. This is true since resistance of inside wall of the hole is low (due to absorption of moisture at hole where protective varnish is broken), hence contact made by the thread edges is as effective as that made by the tapered pins. Insulation resistance between the 11/16-in. surface washers was too high to be measured accurately. Resistance between the bolt and nut terminals with 11/16-in. washers is greater than with either bolts alone or tapered pins, due to the increased leakage at the holes due to moisture absorption.

RIGHT IN THE WAY

THE RULE RATHER THAN THE EXCEPTION

THE MURRAY CROWSNEST IS THE ANSWER

TO THIS EVER-PRESENT LIGHT SERVICING PROBLEM

When an automobile is parked beneath the street light that requires servicing, no problem is presented to the maintenance man whose truck is equipped with a Murray Crowsnest.

Whether the street has heavy or light traffic, servicing proceeds without delay—makes unnecessary returning later to do the job.

If street is well travelled, the service truck is driven in front (right hand illustration) or to the rear of the parked car and the Crowsnest rotated to "spot" the light. There's no question of obtaining the position needed, for full 360° is available.

In a street on which traffic is light, servicing is done over the parked car. It's obvious this method is seconds speedier.

The platform on which operator stands operates automatically. When inner section is raised the platform opens—as section is lowered it collapses. The platform is fitted with a level adjustment to suit the inclination angle.

The flexibility of the Crowsnest is extraordinary and the hundreds of positions it affords, allows for servicing a wide variety of standards. Servicing of Greater New York's street lights is a definite example.

Give your men this speedily operated, safe, economical and all-purpose ladder-rig and maintenance expense will be a minimum. A 20 page illustrated bulletin gives details.

Metropolitan Device Corporation
1250 Atlantic Ave., Brooklyn, N. Y.

THE ALL-PURPOSE LADDER-RIG

Effect of Terminal Spacing on Insulation Resistance

Hours Conditioned	Terminal Spacing "D"	Specimen A-1284			Spec. A-1288
		Tapered Pin Terminals			Bolts and Nuts with 11/16-In. Dia. Washers
		0.140 In. Dia.	0.218 In. Dia.	0.562 In. Dia.	
18	1/4	3.4 x 10⁸	3.9 x 10⁸	3.1 x 10⁸	5.0 x 10⁸
	1/2	1.1 x 10⁴	8.5 x 10⁸	6.0 x 10⁸	9.0 x 10⁸
	1	2.2 x 10⁴	2.0 x 10⁴	1.3 x 10⁴	1.0 x 10⁴
68	1/4	9.0 x 10⁸	9.5 x 10⁸	6.8 x 10⁸	1.3 x 10⁸
	1/2	2.3 x 10⁸	1.9 x 10⁸	1.3 x 10⁸	2.2 x 10⁸
	1	4.7 x 10⁸	4.4 x 10⁸	2.9 x 10⁸	2.8 x 10⁸
164	1/4	3.8 x 10⁸	3.6 x 10⁸	2.5 x 10⁸	5.1 x 10⁸
	1/2	8.0 x 10⁸	7.0 x 10⁸	4.8 x 10⁸	8.0 x 10⁸
	1	1.7 x 10⁸	1.6 x 10⁸	1.0 x 10⁸	1.1 x 10⁸

the same diameter, thus contacting the hole at the thread edges only; (c) tapered pin terminals having diameters of 0.140 in., 0.218 in. and 0.562 in. inserted in holes shaped with a tapered reamer; (d) terminals requiring no holes but consisting of two slightly belled 11/16-in. diameter washers clamped to both sides of the specimen with C clamps.

Specimens of sheet insulating material (Phenolite) were rectangular in shape; 3½x7½x41/16 in., the thickness of all specimens studied. So that the insulation resistance measurements would be independent of the specimen size, all specimens were provided with a guard which consisted of lead-foil strips stuck to the edges of the specimens with petrolatum, as shown.

Specimens each equipped with one of the four different types of terminals were mounted on a rack and placed in a humidifying chamber where air was maintained at 90 per cent relative humidity at 25 deg. C. Connection to the terminals on the specimen in the chamber were made through a sulphur terminal block built in the wall of the chamber. The chamber was not opened until all measurements were made. The curves shown herewith are typical of the data obtained from these tests.

The effect of spacing upon the measured insulation resistance is shown by the data listed in the accompanying table. These latter results were obtained using three sizes of tapered pin terminals and also with 3/16-in. bolt and nut terminals with 11/16-in. washers. Measurements were made with both type terminals so spaced that D (see circuit diagram) was ¼, ½ and 1 in. Measurements on the tapered pin terminals show that for each of the three sizes the results are in the proportions of 1 to 2 and 1 to 4, which are the proportions of the hole spacings of ¼, ½ and 1 in. Similar results for the bolt and washer terminals do not show this proportionality. In order to make D of these terminals equal to ¼, ½ and 1 in. the hole spacing was ¾, 1 and 1½ in. respectively. The results are in the proportions of 1 to 1.7 and 1 to 2, which are close to the proportionate hole spacings of 1 to 1.3 and 1 to 2.

•

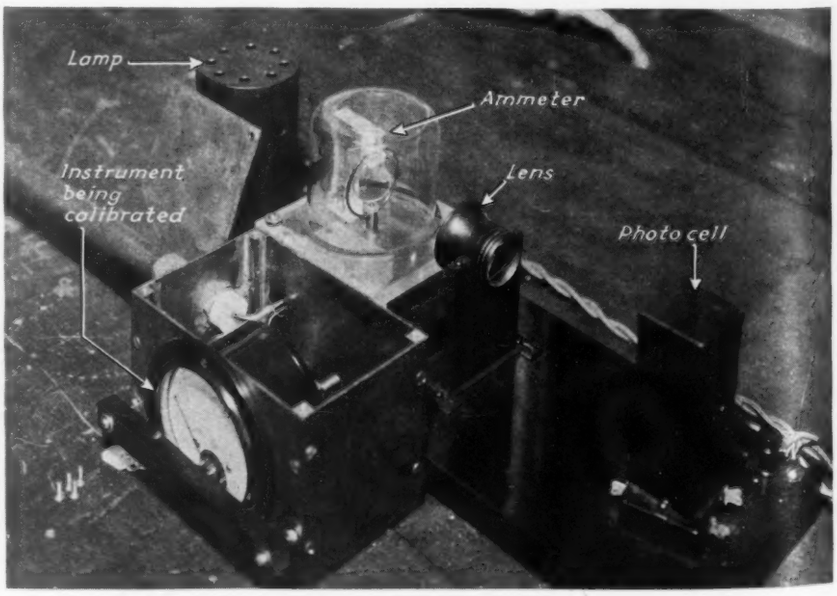
Current Standard for High Frequency

An oscillating-ring electrodynamic ammeter which is a standard of current at high frequencies has been developed at the general engineering laboratory of the General Electric Company. This instrument is used with currents from 3 to 6 amp. over the 5 to 42 megacycle frequency range with an accuracy of ± 1 per cent. Its performance can be accurately calculated from measurements of length, mass and time.

High-frequency current flowing in the exciter loop imparts energy to the oscillating ring, which then oscillates about 90 deg. position at a rate proportional to the magnitude of the current, and nearly independent of the frequency of the current. The ring continues to oscillate until the energy is used up in air and bearing friction, usually 20 seconds or more.

A photoelectric oscillation counter is used with a two-pen chronograph and the primary standard of frequency to time the oscillating ring accurately. A standard second of time contactor on the primary frequency standard 1,000-cycle clock actuates one pen of the chronograph, while the photoelectric oscillation counter actuates the other. Thus a tape is obtained on which appears a direct comparison of the period of the oscillating ring with time.

In addition to being a standard of current, this instrument has lower impedance than commercial instruments and therefore has less effect on the circuit into which it is connected. According to H. R. Meahl (G.E.) who described the instrument before the New York section of the Institute of Radio Engineering, the ammeter should prove valuable in improving the accuracy of current measurements at high frequencies.



High-frequency electrodynamic ammeter in position to calibrate a 3.5-in. instrument

LEAD IN BUILDING *load* WITH *Standard* COMMERCIAL RANGES!

(Also available in white porcelain enamel.)

● Standard produces a line of commercial ranges—modern in design, moderate in price and high in quality, which opens up thousands of new outlets for making profits and building greater load. Hot dog stands, lunch rooms, restaurants, dine-and-dance places, schools, soda fountains—thousands of small operators that need and want the advantages of electric cooking and will welcome advancements Standard has to offer.

Hundreds of Standards are now in operation and giving excellent service. They are proved in use and supported by 25 years' experience in building Standard ranges for hundreds of thousands of homes, hotels, apartments and even private yachts.

SENSATIONAL SELLING FEATURES . . .

The new *Kalmax surface heating unit*—more speed, easy cleaning, new even glow heating, new flexibility, new beauty, new economy. The new *Even-Oven* with 5 super features—even heating, extra capacity, pressed oven runners, extra insulation, smokeless broiling.

This market is ready and waiting to be sold. Send for Standard's complete selling proposition and catalog showing the many models.

There's money to be made - send this coupon - Now!

STANDARD ELECTRIC MANUFACTURING CORPORATION
TOLEDO • OHIO

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☐ Please ship me sample range as shown.

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EW-5

News ABOUT PEOPLE

Los Angeles Utility Men Assume New Sales Duties

H. C. Rice, who was made manager of domestic sales for the Southern California Edison Company in a reorganization of the sales departments, has been head of the company's merchandise department since 1926. Under his new title he will continue to direct activities of the merchandise department, which is concerned primarily with sales of domestic electrical equipment, including home lighting.

H. C. Rice

G. N. Hawley

Mr. Rice entered the electrical industry as an employee of the Beacon Light Company in Los Angeles and later was with the Great Western Power Company, San Francisco, and the Vallejo Light & Power Company. His first work with the Southern California Edison Company was in 1917 in the domestic equipment merchandising division. In 1919 he was made chief appliance salesman, subsequently assistant merchandising manager and was appointed head of the department in 1926.

George N. Hawley, who has been made manager of industrial sales, has been assistant new-business manager of the company since 1935. Prior to joining the Edison organization, he was with the J. L. Mitchell Electrical Contracting Company, Oxnard, Calif., for three years and with the Westinghouse Electric & Manufacturing Company, Mansfield, Ohio. Upon joining the Edison organization, after three years with Westinghouse, he was engaged in the industrial heating development of the company's commercial department.

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▶ C. W. POMEROY, secretary of the Westinghouse Electric & Manufacturing Company, has recently been elected a member of the board of directors.

▶ HARRY BERMAN of the Consolidated Gas, Electric Light & Power Company of Baltimore, has been appointed a member of commercial vehicle committee of the Baltimore Safety Council.

▶ ALLEN N. CARTWRIGHT, vice-president of the West Penn Power Company, Pittsburgh, Pa., has been elected to the board of directors. PHILIP H. POWERS, a vice-president, and WILFORD H. SWINNEY, comptroller, have also been elected to the board.

▶ HOWARD COONLEY, chairman of the board of the Walworth Company, was elected to the board of directors of the Engineers Public Service Company at the recent annual meeting of shareholders. He is succeeding the late Walter B. Walker. In addition to his connection with the Walworth Company, Mr. Coonley is a director of numerous other corporations, and also is director and treasurer of the National Association of Manufacturers.

•

J. D. Roth Appointed Head of Valuation Department

J. D. Roth has been appointed superintendent of the newly organized inventory and valuation department of the Duquesne Light Company, Pittsburgh, Pa. Mr. Roth is a native of Wheeling, W. Va., and was graduated from the University of Pittsburgh in sanitary engineering in 1917.

From 1917 to 1922 he was connected with Morris Knowles, Inc. He joined the Duquesne Light Company in 1922 as assistant engineer in charge of valuation. He was appointed valuation engineer in 1925 and held that position until his recent appointment.

•

▶ CHARLES H. BLISS has been elected president of American Utilities Service Corporation, Chicago, succeeding PERRY CRAWFORD, who has resigned to become vice-president of Central Service Corporation, Chicago, both positions effective May 1. Mr. Bliss, who for the past 22 years has been associ-

The Home Telephone & Telegraph Co., Fort Wayne, Ind., uses this Half-Ton International Model D-2 Truck in its maintenance and service work.

You Can Get More for Your Money in a Truck Today . . . in These New INTERNATIONALS

Beautiful styling and sound engineering are combined in these trucks to provide important advertising value and peak performance at low operating cost.

You probably have admired the streamlined exterior of the New Internationals . . . when you examine and drive these trucks you will admire the many engineering improvements which are advancing the International reputation in the hands of thousands of new owners. And when you put them to work you will be more than pleased with their greater earning ability on your jobs.

Every type of load—every kind of hauling—can be exactly suited by these new Internationals. There is a full line, 25 models in 81 wheelbases, from the Half-Ton unit to the powerful Six-Wheelers that are licking the toughest trucking conditions in the world. See our nearby Company-owned branch or International dealer for complete details on the New Internationals.

INTERNATIONAL HARVESTER COMPANY
(Incorporated)
180 North Michigan Avenue Chicago, Illinois

INTERNATIONAL TRUCKS

Highway

HIGHWAY EARTH BORING AND POLE SETTING MACHINES

Build power lines any time at low cost: The Highway reduces the time element in every operation and lightens the amount of manual labor. It adds a higher degree of safety and is of great value in cutting the time for completing new construction programs in any season of the year. With the Highway mounted on truck or tractor you can bore at difficult angles and in hard-to-reach places. There are many types and sizes available.

HIGHWAY WINCHES

• They save costs in time, labor, and maintenance. There is a Winch for every need—even types light enough to use on 1½ and 2-ton trucks. They are easier to use and stay in service. Smooth operation under heavy duty. Read descriptions in our catalog.

HIGHWAY DERRICKS

• Simple to use. High factor of safety. Size and capacity for any height and weight of pole. Dependability under all conditions insures savings in costs. Fully described in catalog and literature.

HIGHWAY TRAILER CO.
EDGERTON WISCONSIN

ated with E. H. Rollins & Sons, Inc., has resigned as vice-president in charge of the Chicago division. Mr. Crawford has been president of American Utilities Service Corporation since its organization, and was formerly vice-president and general manager of the California Oregon Power Company.

•

Keasbey & Mattison Assigns New Duties to Spaulding

Arthur B. Spaulding has recently been appointed sales manager of the new asbestos-cement pipe and conduit division of the Keasbey & Mattison Company, Ambler, Pa. Mr. Spaulding is well known in the electrical industry, having spent approximately ten years with the Public Service Electric & Gas Company of New Jersey acting

as assistant to the division agent in charge of sales in Hudson County. During his service with Public Service Electric & Gas he served on several national committees of the N.E.L.A. and was very active in the Illuminating Engineering Society. For a period of five years Mr. Spaulding was manager of the electric and public utility department of the Johns-Manville Corporation in the Philadelphia district.

Mr. Spaulding entered the employ of the Keasbey & Mattison Company in 1925 and has been with it continuously since that time with the exception of a short period when he served with the engineering bureau of the Pennsylvania Public Service Commission and with the Utilities Service Company of Allentown, Pa.

The new division of the Keasbey & Mattison Company, which Mr. Spaulding is heading up, will manufacture asbestos-cement cable tubing and conduit for electrical purposes and pressure pipe for the conveyance of fluids and gases. New factories have been erected at both Ambler, Pa., and St. Louis, Mo., for the exclusive manufac-

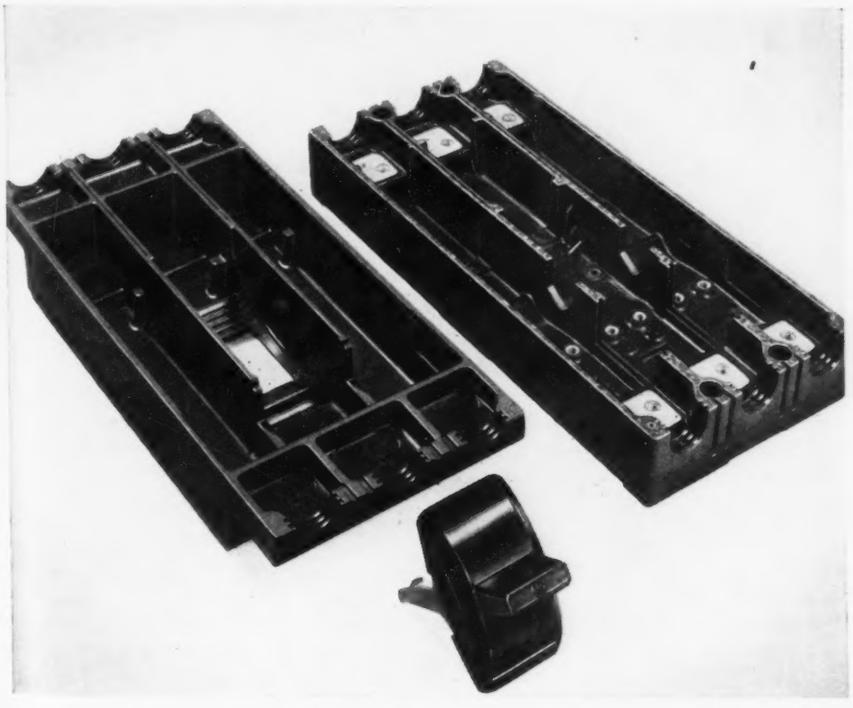
RUGGED INSULATION *Formed to Close Tolerances*

TO USERS of electrical equipment, an unusual advantage of Bakelite Molded insulation is its high mechanical accuracy. Many devices now can be made to operate more smoothly and dependably because all the insulating parts fit accurately.

A typical instance is the new 600 amp. I.T.E. Circuit Breaker housing illustrated. Weighing 21 lbs. with metal inserts, this two-piece insulating case of impact-resistant Bakelite Molded is produced within tolerances of ten one-thousandths of an inch for depths and spacings. Warpage is held below fifteen one-thousandths.

Such precision has been impossible to obtain with some other widely-used dielectric materials. Also, Bakelite Molded insulation is tougher...more resistant to shattering...and more durable under extreme weather conditions. In a wide variety of equipment employed by the electrical industry, it contributes to better operation and lower maintenance costs.

To progressive power engineers and equipment designers, we shall be pleased to furnish complete up-to-the-minute information about the many types of Bakelite plastics available for electrical insulation requirements. Write for Portolio 3, containing illustrated booklets describing these materials.



Photos show I. T. E. 600 amp. Circuit Breaker housing precision-formed from Bakelite Molded. Overall size 19½" x 9" x x 5¾". *Molder: Tech-Art Plastics Co.*

BAKELITE CORPORATION, 247 PARK AVENUE, NEW YORK, N.Y.

BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Canada *West Coast:* Electrical Specialty Co., Inc., Los Angeles and San Francisco, Cal.

BAKELITE

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MAKE YOUR GROUND RESISTANCE MEASUREMENTS

THE "MEGGER" WAY

"Reads like a Voltmeter"

IT IS difficult to exaggerate what the "Megger" Ground Tester has done for the electrical industry. It has made a complicated and expensive procedure simple and low in cost. It has made it possible for any one to measure resistance to earth of ground connections quickly and accurately.

By the use of this method of ground testing, there has come a better understanding of grounds and grounding connections, with an increase in safety, and improvement in the performance of lightning arresters and other equipment.

A "Megger" Ground Tester will serve as your "Court of Appeal" in questions involving grounding. And for your miscellaneous tests "out on the system", our more recent "Meg" Ground Tester is light in weight and low in cost.

Write today for descriptive Catalog 1425-W.

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

Other Biddle Specialties:

"Megger" Insulation Testing Instruments
"Megger" Capacitance Meter
"Ducter" Low Resistance Testing Sets
"Dionic" Water Tester
"Frahm" Vibrating-Reed Tachometers and Frequency Meters
"Jagabi" Rheostats
"Jagabi" Speed-Measuring Instruments

ture of these products, and production is well under way.

•

▶ J. HOWARD TEAGAN has been appointed export manager of the Universal Cooler Corporation, Detroit, Mich.

▶ J. O. SPEED, formerly head of the safety department of the Alabama Power Company, has been made head of the recently established industrial relations department, which will be devoted mostly to safety education, personnel work and employee training.

▶ R. A. HUDSON has been appointed superintendent of the Gadsden steam plant of the Alabama Power Company, to succeed W. L. Boss. Mr. Hudson had been assistant superintendent of Jordan Dam.

▶ FRANKLIN E. BELL, assistant construction engineer on the Joe Wheeler Dam on the Tennessee River, has assumed new duties at Guntersville Dam, another of the TVA projects. Following graduation from Alabama Polytechnic Institute in 1921, Mr. Bell entered the employ of Stone & Webster. In 1922 he entered the service of the U.G.I. Contracting Company and remained with it and its successor until joining the TVA staff in 1934. His experience covers all phases of construction work from electrical foreman and engineer to construction superintendent in charge of installation of high-pressure steam installations, electrical substations and extensive engineering work on paper mills. Mr. Bell is vice-chairman of the Muscle Shoals section of the A.I.E.E.

▶ VICTOR A. HANSON, vice-president and chief engineer of the Power Transmission Council, has been transferred from Boston to Detroit, Mich., where he will conduct a transmission survey of manufacturing plants allied or identified with the automotive industry. He has been located at the Boston headquarters for the past two years.

▶ GEORGE M. HARDY, superintendent of distribution, Worcester County Electric Company, and for 45 years an employee of that and the predecessor Worcester (Mass.) Electric Light Company, was presented with a 21-jewel Hamilton watch at a recent dinner in his honor by associates in this utility. A verbal tribute to the career of Mr. Hardy, one of the best known electrical operating men in the northeast, was given by Thomas G. Dignan, general manager of the company, and Harry Hanson, treasurer of the New England Power Association, with which the company is affiliated, conveyed the greeting of President Carl S. Herrmann of the New England organization.

Electrical Men Appointed to Philanthropic Committee

Howell H. Barnes, Jr., commercial vice-president of the General Electric Company, will head the committee to solicit firms of the electrical industry for contributions to the $10,000,000 campaign of the Greater New York Fund to supplement the finances of private welfare and health agencies. The Fund has also announced that William J. Donald, managing director of the National Electrical Manufacturers Association, has volunteered his services to assist the committee which will solicit trade associations; and that Charles A. Tattersall, secretary of the Niagara Hudson Power Corporation, will be chairman of the public utilities division.

Mr. Barnes has often served as a leader of the industry in philanthropic activities. The Fund's campaign is the city's first united appeal to business and employee groups in behalf of welfare and health agencies.

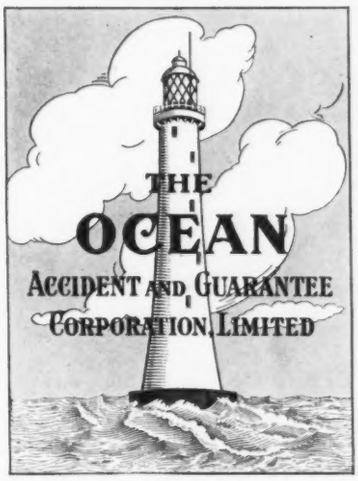
Winthrop Rockefeller, executive vice-chairman of the Fund, said: "I am confident that the electrical industry will give wholehearted support to the efforts of Mr. Barnes and his committee. We have already had many indications of support from all divisions of the industry and the impressive list of sponsors of the Fund from this field indicates that the several divisions will more than meet their share of our goal."

•

▶ R. T. MURPHY has been elected president of the Victoria Electrical Association, Victoria, British Columbia. Mr. Murphy is head of the Murphy Electric Company, Victoria.

▶ BURTON M. RIKER has been appointed assistant sales manager of the commercial equipment department, Toastmaster products division of the McGraw Electric Company has announced. Since 1929 he has been manager of commercial and industrial sales for Rockland Light & Power Company, Nyack, N. Y., and prior to that he was with Charles H. Tenney & Company of Boston as industrial heating engineer. In 1928 Mr. Riker won the James H. McGraw N.E.L.A. prize award for his paper on "Electric Heating." Chairman of the national commercial cooking committee of N.E.L.A. for several years, he later followed the promotion of commercial cooking sales for the power and heating committee of E.E.I. He is at present a member of the National Commercial Electric Cooking Council. Mr. Riker will be located at Elgin, Ill., where McGraw Electric has recently completed its new plant.

COMPLETE *INSPECTION AND INDEMNITY* PROTECTION



for Industrial and Utility

POWER PLANTS

- As the experienced operator of power equipment you know the hazards involved and the precautions necessary to be taken.
- You know that Protection has two distinct phases: 1, Defect Detecting and Accident Preventing Inspection; 2, Certain and Prompt Loss Indemnity.
- Finally, you want this Complete Protection engineeringly adapted to your individual plant conditions to give you adequate protection at low commensurate cost.

The "Ocean" and "Columbia" Insurance Systems salute the Power Executives and Engineers of the World and offer you the Complete Protection you need. Inquire of your Insurance Advisor about our standing.

THE OCEAN ACCIDENT & GUARANTEE CORPORATION

COLUMBIA CASUALTY COMPANY

One Park Avenue, New York, N. Y.

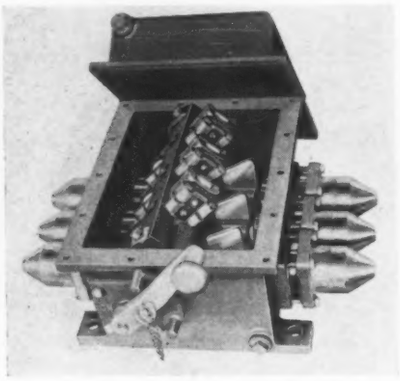
Canadian Branch: **The Ocean Accident & Guarantee Corp., Ltd., Federal Building, Toronto, Ontario**

Cuban Correspondent: **Compania Cubana de Fianzas, Amargura 23, Havana, Cuba**

New EQUIPMENT AVAILABLE

Secondary Switch Boxes

To facilitate disconnection of links, a new line of subway-style secondary switch boxes uses gang-operated links. Boxes



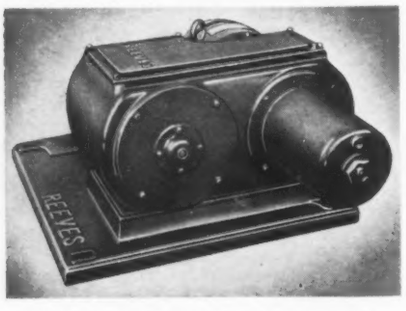
Type "ARA" secondary switch boxes; for two-pole (shown) or three-pole service; rated at 500 amp. and 600 volts. In three-way unit, side cable heads take 500,000 circ.mil and bottom heads 750,000 circ.mil maximum cables. G & W **Electric Specialty Co.**, Chicago, Ill.

are modifications of the company's high-tension Type "RA" switches, adapted to secondary service; the design uses rocker arm links with floating contacts. For non-load break, air-filled boxes are used, oil-filled units being employed for breaking under load. Cable heads, of the wiping sleeve type, used porcelain-insulated "Resistoyl" gasketed connector to provide definite stop joints between cables and box interior. Operating levers can be padlocked in any desired position.

•

Variable-Speed Control

This company is offering a new type of automatic and remote control for use with its "Vari-Speed Motodrive"—speed-control unit combining a driving motor and variable-speed mechanism. Control consists of a bellows-shifting mechanism mounted on the "Motodrive" unit, an adjustable pressure-reducing valve and connecting pipes. Fluid pressure is transmitted to the bellows-shifting mechanism, which operates to increase or decrease speed on the control unit and hence on the driven machine. Speed of shifting depends on fluid used, air being fastest.

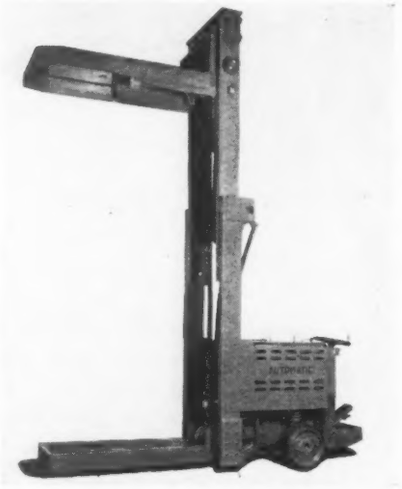


Fluid pressure control, shown mounted on "Motodrive"; capacities from ¼ to 10 hp., speed ratios from 2:1 through 6:1. **Reeves Pulley Co.**, Columbus, Ind.

•

High-Lift Truck

This new telescopic high-lift platform truck was developed to facilitate conserving storage space of materials on skids at unusual heights and still permit transportation under low doorways. Hoisting mechanism comprises a triple spur gear reduction transmission unit powered by an inclosed, heavy-duty motor, having a high overload rating. This unit operates two roller chains which provide complete telescopic platform lift.



Telescopic high-lift platform truck; 5-ton capacity; lifting height of 14 ft. when uprights are fully extended, of 91 in. with uprights collapsed to 119 in.; platform is 36 x 72 x 11 in. high in low position. **Automatic Transportation Co.**, Chicago, Ill.

•

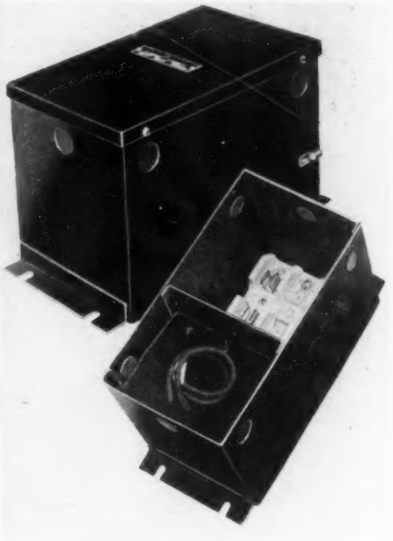
Aluminum-Copper Clamp

Series 744 and 555 tap clamps; for connections ranging from No. 8 copper up to No. O A.C.S.R. **Reliable Electric Co.**, Chicago, Ill.

New line of tap clamps is offered for making connections from aluminum conductors to copper taps. This new clamp is said to distribute the pressure over the aluminum conductor without damaging it and so as to maintain a permanent, low-resistance joint. Contacts are aluminum to aluminum and copper to copper.

Lighting Transformer

A transformer especially designed to permit efficient, individual lighting of electrically operated machines at low cost from high-voltage power circuits is a recent



Type "UL" transformer; for 115, 230, 460 or 575 volts power supply, to supply lamp voltages such as 6, 32, 64 or 115 volts; rated at 75, 150, 225 and 300 watts output. **American Transformer Co.**, Newark, N. J.

announcement. Units are designed to eliminate separate lighting circuits, drop lights and excessive general illumination in shops where machine tools are used. They are intended for mounting on a machine as an integral part and to have output terminals connected to high-voltage power circuit at the motor disconnecting switch. Low voltage for lamps is then available at the output receptacle of the transformer.

•

Insulating Compound

No. 1332 oil-insoluble insulating compound; natural resin base composition. **General Electric Co.**, Schenectady, N. Y.

An oil-resistant filler compound that will not flow at the usual cable-line operating temperatures and that is adequately fluid at recommended pouring temperatures is a recent development. With a base composition of natural resin, the material is said to be particularly suited for use in cable joints and terminals requiring a "solid" filler which must remain stable, physically and electrically, when in contact with insulating oils. Company recommends its use for compound-filled splices and terminals rated 15 kv. and above.

PARTICULARLY ADAPTED TO POWER COMPANY PROMOTION . . .

The New VIRDEN LIGHT CONDITIONER!

Modern, Distinctive, Efficient Lighting for little more than the cost of replacing old-fashioned globes!

See how simple it is to install the new **Virden Light Conditioner!** All that's necessary is to remove the old-fashioned glass globe and replace it with this new unit. The same set screws that hold the globe hold the Virden Light Conditioner.

• This revolutionary new Virden Light Conditioner is the power company's solution to the problem of how to sell more and better light to the thousands of commercial establishments and offices where the cost of complete fixtures and their installation is otherwise prohibitive. This unit merely replaces the ordinary glass globes so frequently encountered, incurring absolutely no expense for installation, and costing little more than the old style globes themselves.

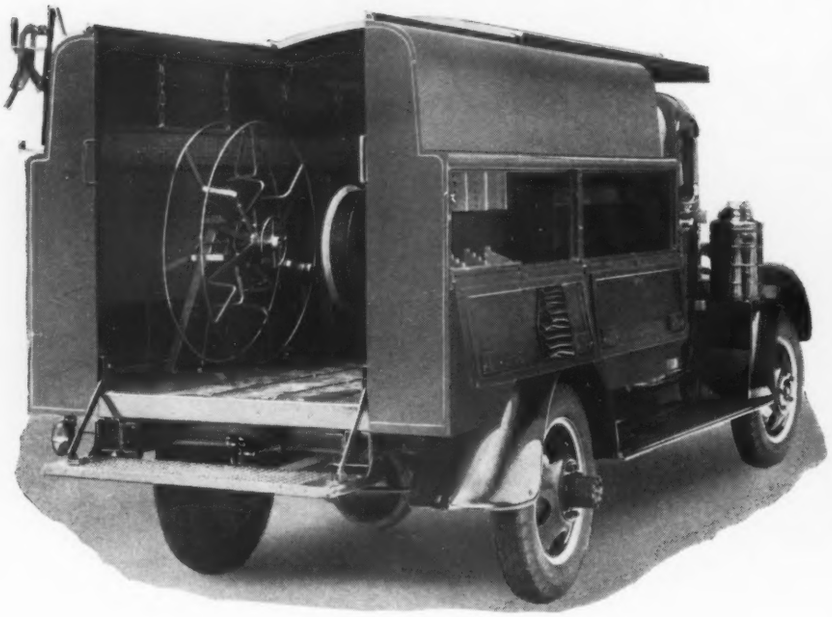
The Virden Light Conditioner is simple in design, yet so efficient in light distribution that it provides all the advantages of expensive types of semi-indirect lighting units. It is smartly proportioned, is designed to permit an abundance of soft, white reflected light and ample glareless direct light, and is available in sizes to fit both the popular 6″ and 4″ standard holders. A 300 watt lamp is recommended for use in the larger unit and a 150 watt lamp in the smaller unit.

Surely, such an item as this is "right down your alley" . . . so, why not plan right now to make it a definite part of your company's promotion program! Complete descriptive material and prices will be sent you on request. Write us ***today!***

THE JOHN C. VIRDEN COMPANY

6009-6103 Longfellow Ave. • Cleveland Ohio

A COMBINATION BODY FOR INSTALLATION AND SERVICE



PRICE
That Will Justify More Units

QUALITY
That Will Lower Your Maintenance Cost

This unit is used in rural or suburban work for (1) installing lines and setting poles, (2) carrying meters and equipment for new installation, and, (3) for general maintenance work. It is a light flexible body made of high-grade auto body steel so fabricated that its construction will withstand very hard usage.

The 4207 body is 102 inches long and is equipped with a sliding metal roof, a drop step tail gate, and a tool compartment. A sheave bar and spool can be supplied for raising small poles. By resting the top of the pole on the spool and backing the truck, the pole is raised to position. A safety sling holds the pole to the truck.

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LARGEST EXCLUSIVE MANUFACTURERS OF

STANDARD UTILITIES EQUIPMENT

FOR MOTOR VEHICLES

THE AMERICAN COACH & BODY CO.
CLEVELAND, OHIO

Capacitors

New capacitor for power-factor correction is designed and constructed to operate out of doors under all climatic conditions. Completely inclosed in a noncorrosive metal cabinet, with special dustproof bus compartment, the unit is suited to platform or pole mounting.

Capacitor pictured is a 180-kva., 4,000-volt, three-phase, 60-cycle pole-mounting unit. **Cornell-Dubilier Electric Corp.**, South Plainfield, N. J.

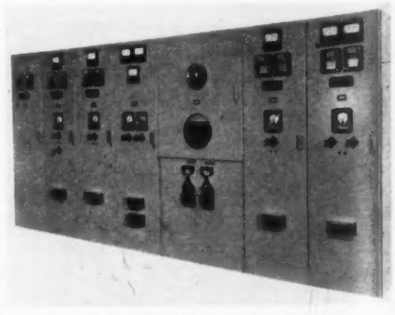
Open Fuse Cutout

Type "OA" cutout. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

For the protection of distribution transformers against overload and short circuit, a new light-weight, open type of fuse cutout has been developed, and is principally designed for use on rural lines above 7,500 volts. Dropout action of cutout is obtained by means of an off-center toggle arrangements of the lower casting. When fuse link melts, toggle is released, upper contact spring drives fuse tube down, further breaking the toggle, until fuse holder is completely released from upper contact and drops into open position.

Metal-Clad Switchgear

This switchgear, intended for medium- or small-capacity central stations includes five standard units, one for an incoming circuit, five for 2,300-volt distribution and street lighting circuits and one special bypass and disconnecting switch unit to permit feeder operation from either the regulated or unregulated bus. Switchgear is of the self-contained vertical lifting and lowering type with removable oil circuit



Metal-clad switchgear unit for medium-capacity stations. **Delta-Star Electric Co.**, Chicago, Ill.

shows industry new ways to electrify further . . .

by case studies and special plant features such as

—"$800 investment saves over $2,000 annually"
—"Experience data — electric welding"
—"Employee attendance 99% constant"
—"Production up 10%"
—"Less handling, fewer rejects"
—"Our heating costs cut 40%"
—"Safe, simple operation"
—"Production increased 15 to 20%"
—"75 years of power at Clark Thread Co."
—"Reliable electric power insures safety"
—"Saving: $35 a month"
—"Biggest electric toaster in the world"
—"Better job in one-fifteenth the time"
—"Heating cable for industrial use"
—"How galvanizing process costs were cut"
—"Tested methods that increased profits"
—"What high-intensity lighting did for a machine shop"
—"$8,000 a year saved"
—"Checking points"
—"What's new in equipment"

- The case studies are selected from outstanding examples in all parts of the country.
- The checking points show how to improve conditions and reduce costs.
- The 'What's New in Equipment' pages keep the reader posted on the latest equipment.

Naturally in this way TIMELY IDEAS stimulates load building action, which explains why over 70 leading utilities throughout the country distribute thousands of copies to power users in industry.

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Manufacturing AND MARKETS

Westinghouse Shows Drop in Net Income

Sales billed for the first three months this year for Westinghouse Electric & Manufacturing Company totaled $42,067,250, as against $46,673,300 for the same period last year, A. W. Robertson, chairman, reported. Billings for the twelve months ended March 31 were $201,742,257, as against $167,161,051 for the preceding year, an increase of 21 per cent.

Orders booked for the twelve months period totaled $193,296,046, as against $214,248,419 for the same 1937 period, a decrease of 10 per cent.

Unfilled orders as of March 31 were $37,998,569, as against $73,735,326 on the same date last year.

Net income for the three months ended March 31 was $2,031,230, as against $5,341,512, in the same period last year. Net income for the year ended March 31 was $16,816,126, against $16,708,349 in the preceding year.

Directors declared a dividend of 50 cents a share on the common and 75 cents a share on the preferred stocks, payable May 27 to stockholders of record May 10.

•

New Electric Alarm Clock

General Electric Company has created a new electric alarm clock, the "Sergeant," which will retail at $2.95. This is the first of a new line of electric clocks, all of which will retail under $5, according to C. R. Thorson, sales manager of the clock section.

•

March Electrical Exports Show Gain Over Year Ago

Exports of electrical machinery and apparatus during March totaled $10,018,000, as against $9,328,000 a year ago, according to the Department of Commerce. For the three months ending March 31, exports totaled $25,507,000, against $24,802,000 in the first quarter of last year.

Exports of household refrigerators in March totaled 17,259, against 16,611 a year ago. For the three months ended March 31, exports totaled 36,585, against 37,348 in the same period last year.

•

Line Material Has Best Year in 1937

Reporting a record profit for 1937, the Line Material Company shows profit amounting to $952,048, which was equal to $4.47 a common share, against $501,004, or $2.35 a share in 1936. In 1929 the company had a profit of $452,533, and in 1928 profit totaled $614,781.

Net sales for the year 1937 increased $2,176,000, or 37 per cent over the 1936 total, to $7,970,000. Gross profit on sales was $2,380,000, against $1,613,000, and profit from operations was $1,195,000, contrasted with $603,000. Net before income taxes mounted from $647,126 to $1,289,000. Taxes took toll of $337,822 last year, more than double that of the $146,121 bill for 1936.

The company has reported that first quarter business in 1938 was 30 per cent below the corresponding period of last year.

Among the other manufacturing reports for 1937 are the following:

JAMES R. KEARNEY—Net profit of $285,030 after charges and taxes, compared with net profit of $209,316 in 1936. Company's sales last year amounted to $2,926,259, against $2,122,535 in 1936. Current assets as of December 31, 1937, amounted to $1,037,113 and current liabilities amounted to $318,827.

DRIVER-HARRIS—Net profit after surtax, $390,535 comparing with $256,636 in 1936. Current assets as of December 31 last, including $382,400 cash, amounted to $1,424,073 and current liabilities were $224,012.

CONTINENTAL-DIAMOND FIBRE—Including wholly owned subsidiaries, net profit, $275,561, equal to 60 cents each on 456,000 shares of capital stock, excluding 49,000 shares held in the treasury. Net profit in 1936 was $595,060, or $1.30 a share on 456,200 shares then outstanding. Current assets as of December 31 last, including $755,438 cash, amounted to $3,515,604 and current liabilities were $517,823.

Range Manufacturer Announces Expansion

Following acquisition of its assets by the Standard Electric Manufacturing Corporation, the 25-year-old Standard Electric Stove Company has reorganized under the former's name, for the purpose of rehabilitation through a reinforced capital structure and enlarged manufacturing facilities. According to Joseph W. Robinson, president of the new corporation, there have been no changes in personnel. In addition to Mr. Robinson, who was associated with the Libbey Glass Company for nearly 25 years, other officers include: Jefferson D. Robinson, vice-president; Charles A. Pierson, vice-president in charge of manufacturing, also heading up and organizing a new research and development department; H. H. Venable, vice-president in charge of sales for the range division, and Ellsworth L. Tait, treasurer.

The corporation plans to engage in a broader and more extensive manufacturing program which will include not only an improved line of electric ranges for both domestic and commercial use but also a wide variety of household electrical apliances.

•

Builds New Rubber Plant

Dow Chemical Company on May 1 opened a modern plant at Midland, Mich., for the production of "Thiokol" synthetic rubber. This plant will be able to supply manufacturers with 2,000,000 lb. of the material annually.

•

Air Unit Sales Up 22% During March

Sales of air-conditioning equipment in March amounted to $5,419,116, against $17,137,869 in March, 1937, a decrease of 68.3 per cent. March sales compared with $4,428,469 in February, 1938, an increase of 22.3 per cent, according to the Air-conditioning Manufacturers Association.

Total for the first three months this

year was $12,444,802, against $31,648,-292 in the similar period of 1937, a decline of 60.6 per cent. While air conditioning sales in March were substantially below the similar month of 1937, they represent a nominal seasonal gain since last December when total amounted to $2,081,672. Also sales in March, 1938, were the largest for any month since July, 1937, when total amounted to $7,508,778.

•

Refutes Age Limit of "40"

Announcement has been made by the Westinghouse Electric & Manufacturing Company that 6,355 of its employees have been with the company for 20 years or more. In its "Annual Review of Industrial Relations" the company revealed that eight of these men have been employed by Westinghouse for at least 50 years and 121 of them have been employed for 45 years. These figures were based upon the year 1937, at the end of which 51,151 persons were employed by Westinghouse.

•

Air Conditioning Booklet

Carrier Corporation has prepared a source book on "Building Year 'Round Load" with air conditioning. It is a utility source book which illustrates the significance of air conditioning load to utilities, the source of markets and other information.

•

Hold Electric Living Show

Commonwealth Edison Company held an electric living show recently at its downtown store, 72 West Adams Street, Chicago, demonstrating the use of many different types of electrical equipment for the home. Cooking schools and electric range demonstrations were conducted by nationally known home economists daily. There were also displays of lamps, radios, laundry equipment, room coolers and other electric home appliances.

•

Porcelain Enamel Booklet

American Rolling Mill Company has issued an attractively illustrated booklet for retailers of porcelain enameled appliances on "Selling Points on Porcelain Enamel."

Art 18; Ed EMG; Dept News

New York Metal Prices

	April 27, 1938 Cents per Pound	May 3, 1938 Cents per Pound
Copper electrolytic	10.00*	10.00*
Lead Am. S. & R. price	4.50	4.50
Antimony	13.75	13.25
Nickel ingot	35.00	35.00
Zinc spot	4.55	4.55
Tin straits	37.60	35.00
Aluminum, 99 per cent.	20.00	20.00

*Delivered Connecticut Valley.

Field Reports on Business

Buying in the electrical industry continues to drag along at a level below a year ago. The pick-up in early April slipped off toward the close of the month. Activities in Washington have tended to make purchasers cautious.

NEW YORK

Business in this area continues spotty, with summer lines coming in for the seasonal increases. Retailers are pushing specials in an effort to clear stocks and reduce inventories. Great emphasis is being placed on small household appliances and the response is encouraging. The housing projects are proving a good sales source, as well as the modernizing kitchen movement.

New York utilities have under consideration a lot of construction work, some of which depends upon the future course of business. Uncertainty regarding what the government will do continues to overshadow the outlook. Opinion among small as well as large business is that there is too much government interference. It is figured that the pump-priming spending will not be felt until next fall.

The preview of the New York World's Fair last week gave indications that a lot of money will be spent within the next year in getting the exhibits ready for the grand opening. Lighting is attracting attention on a large scale. Local utilities are pushing commercial lighting as a load builder. The adequate wiring movement is making for appliance sales prospects in good number. The continued drop in power production is acting as a brake on installation of additional generating capacity. Most utility work now is maintenance and system line work. Rural electrification is being extended to the extent of available funds.

NEW ENGLAND

Orders received during the past week for electrical equipment indicate that buying in this district is dragging along at a slow pace. Small motors are moving singly, but one prominent manufacturer reported the sale of 60 hp. in motors for an air-conditioning installation in a Boston theater; one lot of 50 fractionals was sold to a machine tool manufacturer, and several 5-hp. motors were sold for use in connection with new ventilation systems now being installed.

Utility buying is quiet for the time being, though a fair-sized order amounting to about $13,000, involving switch and control apparatus to be used in connection with a new steam turbine unit which is to be installed in a southern utility, was placed last week. Deliveries of the first portion of a large order for switch and control equipment amounting to about $92,000, to be used with new generating equipment in a prominent utility, are expected soon. Bids are being received for insulators for about 44 miles of new transmission line in Maine; plans are being studied relative to the construction of two new small substations in that district.

A new 400-loaf baking oven, rated at 55 kw. and operating at 500 deg. F., which will require the installation of some accessories including two 37½-kva. transformers, will be bought soon for a state hospital.

New lighting is being considered for a prominent square in Leominster, Mass.; a large volume of work is involved in new water service lines and extensions to pumping systems which should require a fair amount of electrical supplies.

Merchandising is progressing slowly; in the Boston area the major appliance sales show some improvement as compared with a month ago; sales in a Vermont district served by one group of central stations averaged 45 refrigerators and fifteen ranges per week in the past month.

CHICAGO

A few gains and many losses in sales were reported by electrical firms as the month of April drew to a close. After a moderate up-turn in March and first weeks of April, orders fell off rather sharply toward the end of the month. The present situation, particularly in the industrial field, is one of stagnation. Inquiry among a varied list of industries reveals production at low level, with practically no new construction work being done. Purchases of electrical apparatus are limited to replacement parts in a majority of cases. In a few instances, however, the current slack period is being utilized to change over motors and control apparatus and general rehabilitation.

Small appliance sales have maintained a fairly even level, particularly in the suburban and rural areas. Refrigerators, washers and heaters show a far greater decline than the more inexpensive items. The steadily increasing interest shown in electric ranges is most encouraging. Inquiries regarding air-conditioning are increasing, although it appears doubtful that last year's volume will be equalled.

Utility appropriations for new construction are still being withheld, for the most part. Some work on line extensions and small generating units is being done, but the amount involved is comparatively small.

PACIFIC COAST

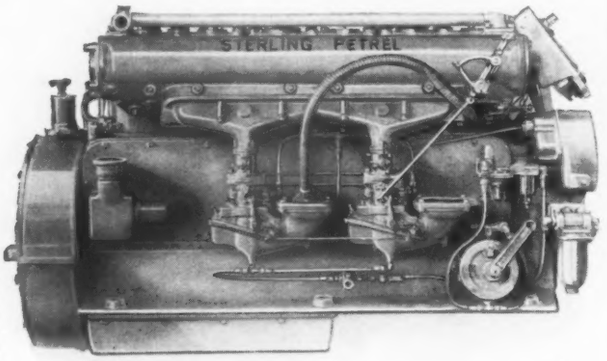
Huge government projects are again in the purchasing stage, awards having just been made for $1,100,000 covering 40 gates for Grand Coulee, $855,000 for 40 gates for Seminoe in Wyoming and $20,000 for transmission towers for Boulder switch yard.

Schools and colleges are furnishing the bulk of public construction and recent school bond elections have been uniformly successful. Larger structures of this type include $650,000 for University of California at Davis and Berkeley and an additional $2,000,000, now being financed, for dormitories at Davis, Berkeley and Los Angeles, and high school plants averaging $450,000 each for Hollywood, San Francisco, Santa Monica, San Mateo, Tucson, Ariz., and Anchorage, Alaska. Hospitals averaging $200,000 each are reported from Watsonville, Pasadena, Ventura, and also Anchorage, Alaska, the electrical contracts for this class of structure usually being double the usual proportionate amount.

New freight rates averaging 10 per cent increase, including intrastate back-haul, are causing a slight though steady price advance in all staples, which is acceptable as forecasting better business from railroads. Major appliance sales are better, though still based rather upon leaders than upon regular reordering; department store business shows an increase.

The Need For Reduced Engine Prices Has Been Anticipated!

Higher speed gasoline, gas and diesel engines cost less and have been abundantly proven in service.



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IMPORTANT

Electrical World

E. E. I. Convention

ISSUE DATES

● As you know, the Edison Electric Institute Convention will be held in Atlantic City on the 7th, 8th and 9th of June. As always, *Electrical World* will do its thorough editorial and reporting job before, during and after the convention. June 4th is the E.E.I. Convention Issue (final closing date May 25th). June 18th Report Number (final closing date June 8th). And the in-between "NEWS" Issue of *Electrical World* will carry a generous news reporting of the occasion.

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. . . COMPLETE LISTS COVERING INDUSTRY'S MAJOR MARKETS

Sales Opportunities

PENSACOLA, OKLA.—Grand River Dam Authority, Vinita, Okla., will receive bids until June 3 for main generating units and auxiliary equipment for new hydroelectric generating plant on Grand River, near Pensacola, including four 20,000-horsepower vertical hydraulic turbines, with governors, butterfly valves and accessories, and for one 750-horsepower hydraulic turbine, with governor, valves, etc. (Contract 5); for furnishing and erecting four 16,000-kva. electric generating units and one 625-kva. generator, to be connected to hydraulic turbines noted above (Contract 6); for construction of power dam and power house, former to be of multiple-arch tvpe, maximum height of 150 feet, including penstocks, radial gates and other construction, with cranes, hoists, piping, valves and complete accessories (Contract 7); also for erection of hydraulic turbines previously noted. Entire project will cost approximately $20,000,000. Financing has been arranged through Federal aid. Holway & Nueffer, 2302 East Eighteenth Street, Tulsa, Okla., are consulting engineers.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until May 13 for 161-kv. oil circuit breakers for switchboard room at Chickamauga power station. Also, at same time for 161-kv. oil circuit breakers for switchyard at Guntersville, Ala., power station. Until May 11, for deep-well electric-operated pumping units and accessories for Guntersville power house and spillway dam junction lock, for unwatering service, all as per plans and specifications on file.

CHICAGO, ILL.—Commonwealth Edison Company has filed plans for alterations and improvements in power substation at 7675 South Chicago Avenue, to include installation of additional transformer equipment.

PLATTSBURG, N. Y.—Has plans maturing for new municipal electric power plant, including electrical distributing lines, and proposes to ask bids in sixty to ninety days. Cost about $520,000. Financing has been arranged through Federal aid. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

RICHMOND, VA.—United States Tobacco Company, 650 Fifth Avenue, New York, N. Y., plans installation of motors and controls, regulators, conveyors, air-conditioning apparatus and other equipment in new multi-story plant on Petersburg Pike, Richmond, where site has been selected. Proposed to begin work soon. Cost close to $2,000,000.

LEWISBURG, TENN.—Receives bids until May 24 for electrical distributing system, including power substation facilities and line connection for TVA power supply. Financing has been arranged through Federal aid. Freeland, Roberts & Company, Third National Bank Building, Nashville, Tenn., are consulting engineers.

CHARLES CITY, IOWA—Iowa Public Service Company, Fort Dodge, Iowa, plans extensions and improvements in system at Charles City, where new franchise is being secured, including installation of an ornamental lighting system in downtown district.

APPLETON, WIS. — Wisconsin-Michigan Power Company, Appleton, has plans ma-

turing for proposed extensions in primary and secondary lines in Iron, Dickinson, Menominee, Marquette, Houghton, Schoolcraft, Alger, Ontonagon and other counties in Upper Peninsula area, and will provide service facilities for over 400 additional rural consumers in that district.

MEMPHIS, TENN.—Memphis Light and Water Commission plans early call for bids for transformers, switchgear, lightning arresters and other equipment for power substation D, in connection with new municipal electrical distribution system, using TVA power. Station is estimated to cost close to $250,000, with equipment.

CUSTER, S. D.—Consolidated Power & Light Company of South Dakota, Deadwood, S. D., plans extentions in transmission line from Big Bend to Custer. Company also plans improvements in cooling water system at steam-electric generating plant at Deadwood, including installation of tower with capacity for handling about 10,000 gallons per minute.

RIVERSIDE, CALIF. — Nevada-California Electric Company, Riverside, plans new outdoor power substation in Arlington district, near Riverside, with installation of two step-down transformer banks to handle 33,000-volt transmission lines, switchgear and auxiliary equipment. Station will be increased in capacity at later date.

CLARKSVILLE, TENN.—Will receive bids until May 17 for municipal electrical distributing system, including poles, wire and cable, pole line hardware, etc., comprising first section of new system to use TVA power. Cost estimated at $85,000. Entire project will represent investment of about $215,000. Financing has been arranged through Federal aid. R. B. Newman, Jr., is engineer.

PRINCETON, IOWA—Peoples Light Company, Davenport, Iowa, plans extensions and improvements in electrical distributing system at Princeton, where new franchise is being secured.

GERING, NEB.—Bureau of Reclamation, Denver, Colo., and Guernsey, Wyo., is considering new power substation in vicinity of Gering, connecting with transmission line for project in that area. Cost about $100,000, with transformers and auxiliary equipment.

CHATTANOOGA, TENN. — Chattanooga Electric Power Board has authorized plans for two power control stations at substations Nos. 3 and 6, and will take bids for equipment at early date. R. H. Hunt & Company, Chattanooga Bank Building, are architects. R. G. Finley is chief engineer for Board.

DICKSON, TENN.—Has contracted with Tennessee Products Corporation for power supply at local plant, and will build a 600-kw. power substation at company works for this purpose, with transmission line for connection with municipal high-tension line securing power from TVA system. Work will begin soon.

RICHMOND, VA.—Richmond Engineering Company plans installation of motors and controls, electric hoists, electric cranes, conveyors, power substation facilities and other equipment in the new local plant for manufacture of air-conditioning and refrigerating apparatus. Company has acquired group of five buildings on Seventh Street, comprising part of former plant of American Locomotive Company, and will remodel and equip at early date. Entire project is reported to cost over $175,000.

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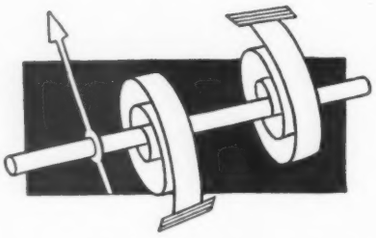

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Recent Rate Changes

UTAH POWER & LIGHT COMPANY has announced that its electric service rates will be reduced approximately $400,000 a year, following a conference between Public Utilities Commission officials and officials of the company. George M. Gadsby, president and general manager, stated the largest saving will accrue to residential and farm consumers, with the remainder being divided between commercial lighting and large power consumers. The new domestic schedule, which became effective April 1, replaces all present rate schedules, except the schedule for refrigeration service which is retained temporarily as an optional schedule. The new monthly rate for residential and farm use is: for the first 11 kw.-hr. in any month 90 cents (minimum charge); for each of the next 25 kw.-hr., 5 cents; for each of the next 164 kw.-hr., 2.5 cents; for each additional kilowatt-hour, 1.5 cents. Mr. Gadsby explained this low residential and farm rate is a reduction in the minimum charge from $1.00 to 90 cents and also a decline in the rate per kilowatt-hour. Other major changes to be made are: commercial lighting rates will be reduced July 1; a change in power schedule will be filed whereby the capacity required by the consumer will be measured over a fifteen-minute interval instead of a five-minute interval as heretofore; the deferred payment charge on residential and commercial bills will be reduced from 10 to 5 per cent, effective July 1; in addition, time in which residential and farm bills may be paid without addition of the deferred payment charge has been extended to fifteen days. Heretofore it was ten days.

UNITED ILLUMINATING COMPANY has announced a reduction in electric rates, which the company estimates will result in an annual saving of approximately $500,000 or more to consumers in New Haven and Bridgeport. The reduction went into effect May 1. In announcing the reduction officials of the company said that further moves in this direction might be expected from the company in the future, as soon as increased use of lighting, power and appliances, makes it possible. The cut in rates was brought about, the company said, by increased use of electric energy during the past year. Electricity users billed on the regular residence lighting schedule now averaging $3 per month will be billed for $2.64; those averaging $4 under the old schedule will pay $3.38 under the new, and those paying $5, $4.02 under the new. Those being billed on the residence cooking and water heating schedule averaging $6 under the old, will pay $5.52 under the new schedule; those paying $8, $6.92 and those paying $10, $8.41.

WISCONSIN PUBLIC SERVICE COMMISSION has announced that rate reductions authorized during the month of March totaled approximately $108,000 a year of which 11,260 users of electricity are to receive reductions of $94,008.

STATEN ISLAND EDISON CORPORATION'S proposal to put into effect reductions in charges for electric service, which, it is calculated, will save customers about $500,000 annually, has been accepted by the New York Public Service Corporation. Members of the commission's staff will confer with officers of the utility to work out new rate schedules.

NEW YORK PUBLIC SERVICE COMMISSION has announced that its recent order direct-

ing a reduction of $14,000 in the rates of the Oswegatchie Light & Power Company has been amended by the commission so as to reduce the reduction by $2,000.

•

Municipal Plants

RUSSELLVILLE, ALA.—Dyer Electric Company of Birmingham has been awarded contract for the construction of a complete electric distribution system for the city. The bid was $87,000 for the work, which will include poles, meters, connections and all accessories.

HARTSELLE, ALA.—City has awarded a contract to the Brice Building Company of Birmingham for construction of a municipal power system at cost of $48,762. Energy will be purchased from the TVA.

EUNICE, LA.—City is considering new municipal electric power plant and will arrange for surveys and estimates of cost at early date, when engineer will be selected.

ABERDEEN, MISS.—The right of the city to install an electrical distribution system to be connected with TVA and to be operated in direct competition with the Mississippi Power Company has been upheld by the United States Fifth circuit court of appeals at New Orleans. In rendering its decision, the circuit court upheld Judge Allen Cox of the northern district court of Mississippi in dismissing a suit filed by the power company seeking to enjoin the city and Secretary of Interior Harold L. Ickes, PWA administrator, from entering a contract whereby federal funds are to be used in providing the city with an electrical distribution system for furnishing TVA power to the community. The power company contended that the contract was beyond the constitutional and statutory authority of the administrator. The utility company also alleged that a contract between the city and the government would be in violation of obligations assumed by the city in granting a franchise to the power company. The circuit court ruling, written by Judge Samuel H. Sibley, said: "The city unquestionably could grant a franchise to another corporation to enter into competition against the Mississippi Power Company. It may enter itself into such competition if it so desires. No law, no contract prevents it."

THAYER, MO.—After two days of using oil lamps and candles, residents on April 16 turned on electric lights. Electric service to the town was disrupted when the Arkansas-Missouri Power Company eliminated power service. Notices posted in the town explained the position of the utility company. They read: "In consideration of the comfort and welfare of the public, we regret that circumstances have forced discontinuance of electric service. Although litigation representing our interest is docketed for reasonably early hearing in the courts, the city administration has authorized immediate procedure in constructing the municipal plant. . . The continuation of service over our lines during construction of the similar lines of the city presents such hazards to both human lives and property that, although we dislike to deprive the public of electric service, we do not feel justified in accepting the obvious responsibility. Should the city administration decide to consider the real interest of the people and remove these hazards by ordering suspension of its construction program until litigation can be completed, the

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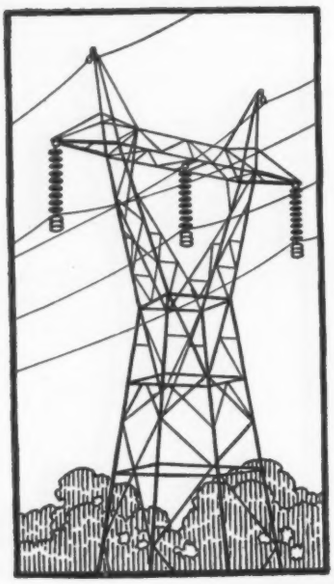

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electric service will be immediately restored. . ." The state Public Service Commission ordered the utility to resume service at once and to "continue rendering said service until further order of this commission." The commission's order said the action had been taken "without authority" and instructed that service be restored "until proper proceedings for abandonment" are instituted.

AUBURN, NEB.—City officials have decided to institute condemnation proceedings to acquire the local plant and electric distribution system of the Western Public Service Company.

COZAD, NEB.—Official returns of the election held recently show that the proposal for the city to issue $275,000 in bonds to finance a municipal light and power plant and distribution system carried by a substantial majority. City officials have announced that the city is willing to purchase the local facilities of the Western Public Service Company provided that the price asked is reasonable.

MINATARE, NEB.—Federal Judge J. A. Donohoe has denied an application by the Western Public Service Company for an injunction restraining the city from constructing an electric power plant, pending appeal of a previous ruling in the case to a higher court. After Minatare residents voted to build a plant to compete with the company, Western Public Service brought suit in federal court seeking "quiet and uninterrupted enjoyment of its lease" in Minatare, but Judge Donohoe sustained a motion by the city to dismiss the action. The utility filed notice of appeal to the U. S. Circuit Court of Appeals and asked the injunction while the appeal is pending.

BELLEVUE, OHIO—Four-year fight by the city for lower light and power rates, which recently led to council's passing an ordinance permitting negotiations for purchase or condemnation of the distribution system of the Ohio Public Service Company, has led to the signing of a contract by city officials with the Western Construction & Engineering Company and W. S. Thurstin, Toledo attorney, to proceed with this work.

CLARENDON, VA.—Citizens' Association will be asked to favor a proposal of Wiley & Wilson, consulting engineers of Lynchburg, Va., for a municipally-owned power system, by Calvin I. Kephart, formerly chairman of the Public Utilities Commission of Arlington County, Va. The Wiley & Wilson survey, ordered by the County Board last fall at a cost of $4,000, discusses several possibilities. The firm was ordered to make the survey on the complaint of citizens that some sections of Arlington County enjoy lower electric rates than do other areas. Those enjoying lower rates are patrons of the Braddock Light & Power Company, while the Virginia Public Service Company, which serves the larger portion of the county, charges higher rates. One plan involves construction by the county of a generating plant and distribution system; a second proposal, and the one which the engineers believe to be the most practicable, is that the county buy its electricity at wholesale prices from a reliable source, and sell the energy to consumers on its own distribution lines. It is this plan for which Mr. Kephart will seek support. His reason is that it will not involve as large an outlay of funds as does the complete system including the power plant. According to the engineers, the distribution system alone will cost $1,475,000 and the complete system $3,075,000.

26th Annual Survey of Large Systems

[*Continued from page 46*]

with a few minor gaps, through the period from 1931 to 1937 inclusive. Their output, generated and purchased, in 1937 constituted 55 per cent of the total for all companies represented in the Supplement and they are probably a fair sample.

Their aggregate output decreased from 1931 to 1932, and since that year has been steadily increasing. The same is true of the aggregate of the peaks. Until 1937 the two sets of totals were approximately in step. What may, for convenience, be called the "combined load factor" varied within narrow limits, though with a slightly upward trend since 1932. In 1937 it rose sharply. Of the 30 systems, only 22 had higher peaks than in 1936, whereas all but two increased their output. The aggregate output advanced 9.3 per cent, the aggregate peak only 3.7 per cent. The combined load factor consequently rose from 54.8 per cent in 1936 to 57.8 per cent in 1937, the latter being larger than in any previous year of the period.

In passing, it may be remarked that the "combined load factor" as described above differed only slightly from the unweighted average of the individual system load factors for any given year.

Why the jump in load factor in 1937? Until the last quarter, the consumption of energy was well above 1936. The peak of demand, however, usually comes in December on most systems. In 1937 the depression had by that time grown to serious proportions. The corresponding reduction in output had only a moderate effect on the annual total, but the lowered peak directly diminished the ratio referred to 1936. The load factor was abnormally high.

Domestic service rising

It is well known that the average use of energy per domestic customer is steadily increasing in the country as a whole. Comparison of data in the current Supplement with those of other years indicates that this is true also of the various geographical regions, but that the regional averages differ widely among themselves. The chart shows these changes over a period of nine years. In the

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Protected by a double thick coat of zinc, bonded securely to a strong steel body by the special Oliver Double Dip Hot Galvanizing Process, Oliver Pole Line Materials are provided with the greatest resistance to rust and weather deterioration,—an outstanding quality that has made Oliver a standard specification for many years.

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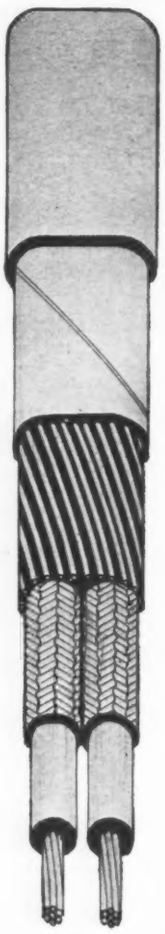

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United States as a whole the average domestic consumer increased his requirements from 492 kw.-hr. in 1929 to 801 kw.-hr. in 1937, on systems in the 100,000,000-kw.-hr. group. The increase amounts to 65 per cent.

Domestic service is expanding not only as to the average per customer and as to the aggregate, but is increasing in ratio to total sales, as will be seen in Table V. In 1929 domestic and farm or rural sales combined were 11.3 per cent of the total to ultimate consumers. In 1937 they were 18.5 per cent. During that period they more than doubled in total amount, whereas sales to all classes of ultimate consumers increased by only one-third.

●

Court Gives WDA Rehearing

Wisconsin Supreme Court has granted a rehearing of the Wisconsin Development Authority case. The high court held in January that the WDA was unconstitutional in that it delegated sovereign powers of the state to a private corporation.

Appearing in favor of a rehearing was Attorney-General O. S. Loomis, while Attorney Harold E. Stafford, Chippewa Falls, special counsel appointed to represent Secretary of State Theodore Dammann, argued against changing the decision. Six briefs were filed with the court by counsel for interested groups.

●

Customer Relations Films

In consultation with the Edison Electric Institute, the Vocafilm Corporation, New York City, has prepared a series of five sound slide films to be used at a series of electrical employee meetings on constructive customer relations. Films are designed to increase knowledge, efficiency and courtesy of the employees. Proper handling of complaints is one of the film subjects.

●

Refrigerator Plan Book

The national program of the refrigerator section of the Modern Kitchen Bureau is described in an eight-page plan book recently issued. It describes test campaigns conducted last fall in Dallas, Tex., and Oklahoma City, Okla., and tells exactly how they may be adapted for use in any other city. Sales helps described in the plan book include a demonstration portfolio, a hand-out leaflet, banners and posters and a salesman's guide to selling electric refrigeration.

STILL TO BE DIVIDED!

Some of these contests that are promoting a banner year for electric water heaters close shortly. Better get moving on that entry of yours — and get your share of the cash and the glory!

$460 For letters from retail salesmen of utilities and dealers on "How I Sell Electric Water Heaters." A contest each month through 1938.

$250 For the best electric water heater window displays by utilities and dealers. Contest closes June 30, 1938.

$400 For the best newspaper advertising campaigns on electric water heaters by utilities and dealers. Contest closes July 31, 1938.

$1,000 And a silver cup as national awards for the operating utility company that does the best all-around electric water heater job in 1938.

DETAILED INFORMATION

and contest rules have been released to all operating utility companies and local Modern Kitchen Bureaus. Ask for information or write to

NATIONAL ELECTRIC WATER HEATING COUNCIL
THE MODERN KITCHEN BUREAU
420 LEXINGTON AVE.
NEW YORK, N. Y.

Electric Water Systems Pave Way for Rural Load

[*Continued from page 48*]

per cent credit toward the purchase of a water pump as selected by the ticket holder. Local dealers found it to their advantage to be on hand to take care of their own prospects and to look over the field for others in their neighborhood interested in the equipment handled by them. A number of sales were made on the spot and numerous prospects were built up for future attention.

Not the least desirable result of this campaign has been the cordiality which has been built up between rival manufacturers and their representatives. In driving about from show to show, often pooling transportation facilities, these men have developed a close friendship and have learned the advantage of refraining from derogatory remarks toward the other fellow's equipment. The dealers showed an equal spirit of good feeling and co-operation. The general result has been a unified front which has reacted favorably on public opinion. The barrage of window displays and general advertising produced the effect that "everybody's doing it."

Thus the rural dweller, the farmer and his wife, have become more readily convinced that they must join in the general procession for more wholesome living and pleasant environment.

Definite figures on sales are not at hand, but one distributor makes it clear that in 1935, the beginning year of this activity, his sales led the nation in the sale of running water pumping equipment in so far as the particular make which he handled was concerned. The next year brought forth a 50 per cent increase in his business and 1937 was 33⅓ per cent above 1936.

Water pump as door-opener

Of course results are cumulative and the full force of this promotion has not, as yet, been fully realized. However, it is our purpose to carry on each spring a well-organized activity of this kind to keep electric pumping and running water systems in the public mind and help the distributors and dealers develop a volume which will return a reasonable profit. We consider water pumping by electricity

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- Only 1 piece to handle (No parts to lose)
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● Unfailing performance is built in every Illinois insulator. Each step in their process of manufacture is closely controlled. Modern facilities and rigid inspections take all the guesswork out of their production. That is why utilities from coast to coast have made Illinois insulators standard equipment.

Our large stock and central location enable us to make prompt shipments.

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of very great importance to the company in rural load building. It opens the door, as perhaps no other appliance does, to the greater use of labor-saving electrical appliances and modern conveniences.

The methods we employed in organizing these selling activities are justified because the dealers, as a group, do not have the facilities, resources and personnel to do it for themselves. It is indicated directly and indirectly that the added revenue from the sale of electric pumps and irrigating systems is substantial. It is not easy to calculate definitely the added revenue for appliances and uses sold after the pump sale has been made, but it is indicated that the kilowatt-hour sales increase, soon after the sale of a piece of pumping equipment, to three times that obtained from the pump and thus the cost of these activities per dollar of estimated annual revenue is relatively small.

Our plans for 1938 contemplate cooperation with electric pump distributors and dealers and call for dealer dinner sales meetings at three important points over the territory. It is also planned to carry on a dealers' prize window display contest that will run a full month. It is expected that this promotional work and sales interest, as carried on and supported by timely publicity, will fit into the present business outlook and produce a volume of new business that will tremendously benefit the jobber and dealer. We feel, too, that this additional program will react very much to the advantage of many of our customers not now experiencing the advantages of running water. An economic well-being will also be promoted through the availability of adequate running water for irrigating their land, regardless of climatic conditions.

•

Bid on 700-Mile Line

Fritz Ziebarth, Los Angeles, branch office Spokane, bidding $165,800, submitted low bid to the Seattle Board of Public Works for stringing 700 miles of wire for Skagit transmission line No. 2, from the Gorge plant to South substation in Seattle. Three bids were submitted, A. S. Schulman Electric Company, Chicago, bidding $172,600 and Acme Construction Company, Seattle, $178,790. Bids were referred to City Light engineering division for recommendation.

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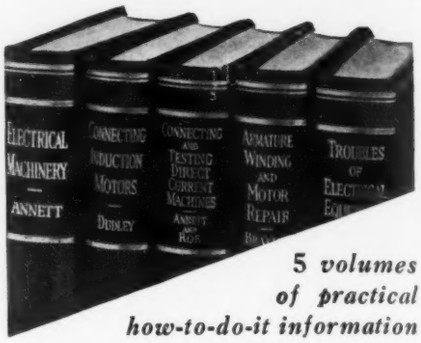

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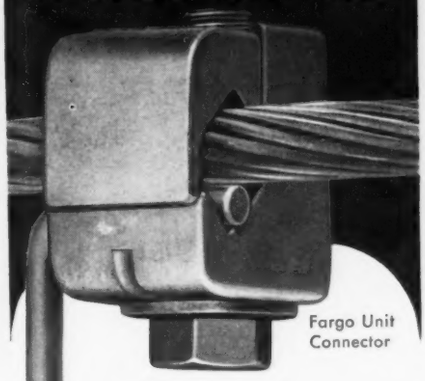

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[*Continued from page 50*]

the contacts open, allowing the solenoid valve to close.

In starting up the generator, carbon dioxide gas is used to displace the air before the hydrogen is admitted. This is necessary in order to avoid having an explosive mixture in the casing. When the hydrogen is being completely removed the above process is reversed.

The hydrogen system is controlled from a central control cabinet located on the operating floor near the generator.

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Retention record good

The hydrogen-cooled generator at Millers Ford power station has been in operation about five months. Operating experience indicates that the normal loss of hydrogen per day due to leakage is between 35 and 40 cu. ft. at atmospheric pressure.

When the generator was first placed in service it was operated with air cooling for a short time. During this period the no-load steam input to the turbine was 98,000 lb. per hour. With hydrogen cooling on the machine the no-load steam input is 80,000 lb. per hour.

Two sets of readings have been taken at approximately full load on the machine with air cooling and hydrogen cooling. These readings show a 24.5 deg. C. reduction in the temperature of the stator, an 18 deg. C. reduction in the temperature of the rotor and a 7.5 deg. C. reduction in the generator cooling medium temperature due to hydrogen cooling.

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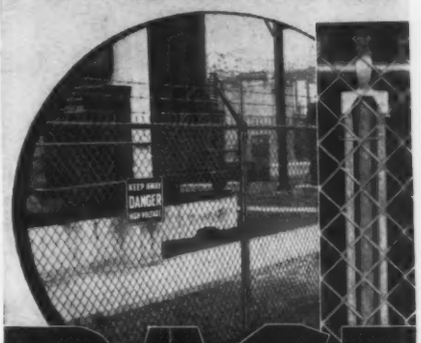

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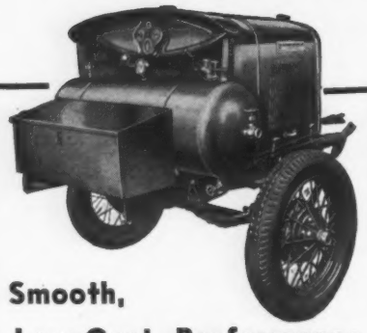

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Improved Wiring Methods Needed to Promote Adequacy

[*Continued from page 52*]

becomes so great relative to the impedance of the circuit within the magnetic envelope that stray currents are negligible. This feature of course, does not hold for d.c. supply.

Applied to existing installations, this use of bare neutral in conduit will bring about substantial improvement in safety by relieving the overloaded condition of many circuits and by effecting their complete and positive polarization.

Thin wall insulation

Vast improvements in rubber processes have been perfected since specifications for rubber-insulated wire were formulated many years ago, and there is now on the market and commercially available safe and dependable rubber insulation very much thinner than the covering which has long been standard for that purpose. Experiments with other kinds of insulations which permit reduced thicknesses with equal or better electrical and mechanical properties are very promising and will surely bear fruit in the near future. Modification of Code rules to permit the full advantage of the space saving in conduit with thin-wall insulation is very much in the consumer's interest as it offers a further practical means of providing greatly increased conductor capacity within a given space.

Greater use of conduit area

For many years one of the reasons urged for the very conservative rule that only 40 per cent of the area of a conduit should be utilized by conductors was that, by this rule, space was provided for further expansion when the load on the wiring installation had grown to a point where more conductor capacity was required. In many thousands of existing buildings the time has now arrived to utilize more of this available space. To do so appears to be in full accord with the original intent of the Code. It is proposed, therefore, that the rules be amended to permit materially greater utilization of conduit area in old installations.

It may be that some limitation to the use of conduit space will still have to be imposed in the case of particularly long and difficult conductor pulls. But is it not reasonable

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to modify the rules to provide for a more economical use of the space in the great majority of conduits, where conditions are such that this can be done without damage to conductors? More careful layout of conduit initially will tend to eliminate these difficult pulls.

Other proposals

The proposal to recognize service cable of the covered neutral type for general indoor use would simplify the operation of extending heavy capacity copper to various heavy load centers in addition to electric ranges. The safety of this practice is above question and it provides greater flexibility where circumstances make such wiring satisfactory from the standpoint of appearances. It will therefore encourage the desirable provision of heavy copper capacity leading all the way to the heavy load centers.

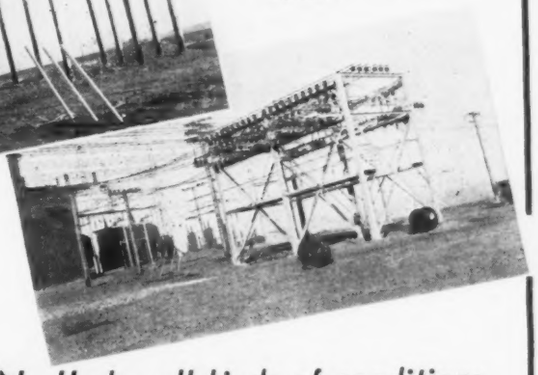
The proposal to remove the requirements for mandatory use of rigid conduit in theaters, elevators, etc., is aimed at removing blanket rules that are needless duplications because the Code in other more specific provisions takes care of all the safety considerations these blanket rules could affect. The rules as they stand fail to recognize the basic principle in the Code that any of the various recognized wiring systems are equally safe when used with types of building construction for which they are adapted. The result of enforcing these blanket rules, in many types of building, is the installation of skimpy permanent wiring and the habitual use of long extension cords. In the interest of adequate wiring and of safety the blanket rules should be eliminated.

The proposal to delete the rule requiring conduit to be shipped in 10-ft. lengths would permit the fabrication of conduit in lengths and shapes proving to be the most economical. The rule has no bearing on the question of safety of wiring installations and its elimination will provide greater flexibility that will tend to give to rigid conduit more of an opportunity to compete with other types of interior wiring.

There is a well-established need and market for raceway types of wiring. The use of bare or covered neutral wire, of thinner insulation and freedom from the requirement that rigid conduit shall be cut in

• *Wood Pole Structure for 6600 v distribution system forming a turn of ninety degrees.*

• *Steel Switching Tower erected at Fort Peck, Montana.*



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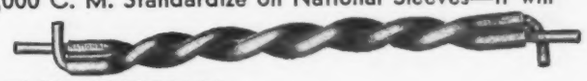

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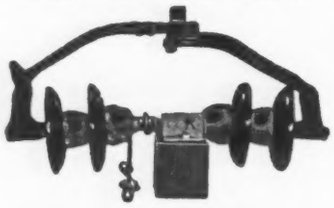

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10-ft. lengths, instead of curtailing the market for raceway types of wiring, will extend their field of application into sectors that have not been within their economic reach under existing Code limitations.

The question of safety

The proposed changes in the Code taken collectively constitute a safety measure of much broader effect than any such measures that have been made in recent decades. They will substantially raise the general average of wiring safety (1) by increasing the conductor capacity and therefore generally reducing the extent to which some circuits may now be carrying overloads, and (2) by tending to supplant makeshift wiring with permanent wiring installed by skilled workmen.

A generous provision of copper conductors leading to a sufficient number of outlets to supply the present and probable future needs of the consumer and readily adaptable to further expansion must inherently promote safety. Examination of the records of authentic electrical fires reveals that a very large proportion are due indirectly to an insufficiency in the capacity of the conductors themselves, the basic element in a wiring system, and to a lack of circuits and outlets which had resulted in improvised wiring.

Let it be clearly understood that the electric utilities are not sponsoring any unsafe wiring materials or methods. They could in nowise afford to increase fire or casualty hazards in the premises of their customers. Their proposals are backed by tests and trial installations and by the judgment of a large and diversified group of persons competent to pass judgment on such matters.

NOTE—In his next and concluding article, Mr. Kellogg will discuss the interest of the other branches of the industry in these wiring proposals and particularly its relation to the National Adequate Wiring Program.

•

Orders Book Corrections

New York State Electric & Gas has been ordered by the Public Service Commission to make corrections in its books so as to take out of fixed capital accounts sums representing two water gas plants and a coke oven plant which an investigation has shown are not used and useful in furnishing service. The plants were used for standbys, but had not been in operation recently.

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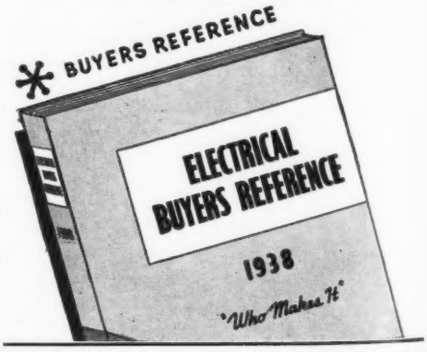

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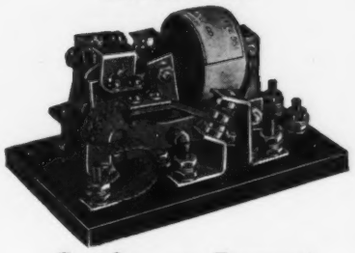

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Chart Compares Protective Devices Characteristics

[*Continued from page 55*]

be altered by the values eventually agreed upon by proper co-ordination between the principal high-voltage testing laboratories.

The curve shown in diagram 3 results from field tests which may also be altered by the addition of more data. The lightning stroke potential expectancy curve is based upon an assumed lightning stroke surge impedance of 400 ohms and lightning stroke currents as measured in the field. This curve may be altered either as to the assumed stroke surge impedance or to additional data concerning lightning stroke current probability.

In diagram 4 it is to be noted that the wet switching surge characteristics have been used in preference to the 60-cycle wet flashover characteristics. It has been found by test that this material difference results when a switching surge is applied to a gap which has a distributed electrostatic field such as is provided by the control gap. This is in contrast to the case of the concentrated electrostatic field which obtains on the standard rod gaps at the electrode tips. In this latter gap no justifiable increase has been found to obtain for the switching surge wet flashover over the corresponding 60-cycle wet flashover.

The data shown in diagram 5 are the results of field measurements. The minimum current as shown in the references is 10,000 amp. The curve has been extrapolated back through the lower regions, being guided by a minimum measured at 500 amp. as shown in Fig. 27 of Lewis and Foust, "Lightning Surges on Transmission Lines—Natural Lightning," November, 1936, *General Electric Review*, applying to distribution arresters, and the fact that 100 per cent of all lightning stroke currents will exceed 0 amp. The nature of this curve may be changed by the introduction of additional field data.

With reference to diagrams 3, 5 and 6, if switching surge and lightning potentials expectancy curves, lightning stroke current expectancy curves and arrester performance characteristics for any particular system and equipment are available, they may be plotted on the chart, thereby permitting the chart to give more accurate comparisons.

Tax-Exempt Securities

[*Continued from page 60*]

Senator Donahey as investigator for the committee, won his spurs back in Ohio while Donahey was making his reputation as auditor, and he indicates there will be plenty of spade work before the hearings actually start.

Meanwhile the Tennessee primary will be held in August, which is a great relief to some of the friends of Senator George L. Berry. It may be recalled that Dr. Arthur E. Morgan did not like the attitude of Harcourt A. Morgan and David E. Lilienthal toward Berry's claim for damages because TVA had submerged his marble.

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Rural Loans Made; New Contracts Let

The following allotments have recently been made by the Rural Electrification Administration:

CALIFORNIA—Surprise Valley Electrification Corporation, Alturas, $27,500 to build approximately 20 miles of line. Project previously allotted $410,000, for 349 miles of line, 809 customers in Modoc and Lassen Counties, Calif., and Lake County, Ore., and $90,000 to construct a generating plant.

FLORIDA—West Florida Electric Co-operative Association, Graceville, $100,000, to build 100 miles of line, 500 customers 226 of which have already signed up, in Jackson, Calhoun and Holmes counties.

OREGON—Umatilla Electric Co-operative Association, Hermeston, $35,000, to build 33 miles of line. Project previously alloted $129,000 to build 126 miles of line, 410 customers in Umatilla and Morrow counties, and $10,000 to finance house wiring and plumbing installations.

CONNECTICUT — Co-operative to be formed, $92,000 to build 92 miles of line, 280 customers in Windham and Tolland counties.

INDIANA—Utilities District of Western Indiana REMC, Bloomfield, $4,000 to complete the project and to defray certain expenses connected with the initial operations of the project which cannot be covered by the construction loan. Project previously allotted $200,000 to build 202 miles of line, 850 customers in Greene County.

KANSAS—Co-operative Power & Light Company, Inc., Iola, Kan., $4,000 to complete the project and to defray certain expenses connected with the initial operations of the project which cannot be covered by the construction loan. Project previously allotted $65,000 to build 65 miles of line to serve 241 customers in Allen and Neosho counties.

WISCONSIN—Trempealeau Electric Co-operative, Arcadia, Wis., allotment of $5,000 to complete project and to defray certain expenses connected with the initial operations of the project which cannot be covered by the construction loan. Project previously allotted $445,000 to build 458 miles of line, 1,230 customers in Buffalo, Eau Claire, Jackson, LaCrosse and Trempealeau counties, and $10,000 to finance house wiring and plumbing installations.

Construction Contracts

CALIFORNIA—Plumas-Sierra Rural Electric Co-operative, Blairsden, to Fritz Ziebarth, Long Beach, for building the entire project, consisting of 208 miles of distribution lines. Low bid, $242,467.

IOWA—Benton County Electric Co-operative, Vinton, to Elkhorn Construction Company, Norfolk, Neb., for building the entire project, consisting of 143 miles of distribution lines. Low bid, $98,225.

MICHIGAN—Alger-Delta Electric Co-operative, Rock, to Clifton Engineering Company, Zeeland, Mich., for building the entire project consisting of 113 miles of distribution lines. Low bid, $96,182.

WISCONSIN—Dunn County Electric Co-operative, Menomonie, to E. W. Wylie, Inc., St. Paul, Minn., for building the first 142 mile section of the project. Low bid, $116,811.

ILLINOIS—Menard County Electric Co-operative, Petersburg, to Sheehan Pipe Line Construction Company, Tulsa, Okla., for building the 2nd and 3rd sections of the project, consisting of 212 miles of line. Low bid, $150,055.

MINNESOTA—Peoples Co-operative Power Association, Inc., Rochester, to Charles Robeck Construction Company, Omaha, Neb., for building the entire project, consisting of 153 miles of line. Low bid, $122,863.

WYOMING—Wyrulec Company, Lingle, to C. E. Atwater Company, Grand Island, Neb., for building the third section of the project, consisting of 151 miles of line. Low bid, $106,323.

•

Japanese Reassure Power Bond Holders

Assurances have been given to foreign holders of bonds of electric power companies in Japan that every effort has been made to protect their interests under a bill recently passed by the Japanese Diet whereby the government is taking over control of the generation and primary transmission of electric power throughout the country. According to advices recently made public by the Financial Commission of the Japanese Government, the Japanese Department of Finance has cabled that the properties mortgaged for the security of foreign bonds of electric power companies are to continue in "factory estates" and to remain mortgaged for such bonds even after such properties have been transferred to the Electric Power Generation and Transmission Company of Japan in return for stocks.

It is expected that the operations of the existing electric power companies and the Electric Power Generation and Transmission Company will be placed on a workable and economic basis so as to maintain a sound financial status of the power industry and also to protect the interests of shareholders and bondholders affected by the program, according to the announcement.

•

Floodgates Prevent Damage

Action of the Alabama Power Company in regulating gates at its several hydro-electric developments on the Coosa and Tallapoosa Rivers aided considerably in controlling the floodwaters in Alabama recently, A. S. Coleman, vice-president, stated. Mr. Coleman said the water at Jordan Dam reached a flow of 300,000 cu.ft. a second, the greatest ever recorded, but that operation of the floodgates at the several dams aided materially in flattening out the flood. The dams were not damaged.